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NEW YORK, MAY, 1889.

THE offices of the RAILROAD AND ENGINEERING JOURNAL were on May 1 removed from No. 45 Broadway to No. 145 Broadway, on the corner of Liberty Street. The correct address of the JOURNAL will therefore be hereafter No. 145 Broadway, New York City.

CURVES and curvature have always been and will always be the most important consideration in locating a railroad, with the single exception of grades, while the curves have even more influence than the grade in the design and construction of the equipment. Anything which relates to curvature will, therefore, always have interest for engineers. Probably no single point in this connection has been the subject of more discussion, or has been more written about, than the method of passing from a curve to a tangent and *vice versa*—that is, the question of transition curves. The article on this subject, the first portion of which will be found on another page, is intended to give a clear and complete account of the theory and practice of transition curves. It is an addition to the series of articles on the Principles of Railroad Location, which was published in the JOURNAL last year, and will make part of the book, when those articles appear in that form. The present article is not only an account of the experience of others, but is the outcome of much practical work in the field, in the location of new and the relocation and improvement of old ones.

THE naval disaster at Samoa is a proof of how much a modern war-ship is dependent upon its machinery in contending with the elements as well as an enemy. The British cruiser *Calliope*, which escaped with comparatively little injury, did so not because she was the better vessel—for the *Trenton* was an excellent ship of her class, and the German vessels were also good ships—nor because she was better handled, but simply because she had more powerful engines, of comparatively modern design. Had the American and the German ships been supplied with such machinery as we are now putting into our new war-ships they would doubtless have been safe to-day.

NEW railroad projects are plenty at the present time. The *Railway Age*, in a recent number, gives a table in which are enumerated no less than 666 projected lines, covering a total of 53,436 miles, while there are 14,818 miles under construction or under contract. Unfortunately, the *Age* does not discriminate between the mileage actually under construction and that merely under contract, since, under the system prevalent in this country, the letting of a contract is by no means always followed by actual work. A great many roads have been under contract for years on which not a shovelful of dirt has ever been turned, and a contract may, and often does, mean simply an agreement to build a road at some future time, provided certain things are done, which may or may not come to pass. Probably a considerable proportion of this road is, or soon will be, under actual construction, but how large that proportion is, it is impossible to say.

As to roads that are merely projected, the organization of a company is so easy a matter in most of the States, that it goes for very little. The only value which a mere list of new corporations has, is that they are more numerous when railroad building is active, and less so in times of comparative depression; but it must be said that the formation of new companies generally continues for some time after actual construction has begun to fall off.

We do not intend, however, to intimate that the present is a time of depression. While it is not probable that new railroad construction this year will come up to the figures of 1887 or 1886, there are many indications that it will not fall very much below those of last year. A good many miles of railroad are needed yet and will be built, and a fair proportion of them will be built this year.

THE MASSACHUSETTS RAILROAD COMMISSIONERS' REPORT.

THE Twentieth Annual Report of the Board of Railroad Commissioners of the State of Massachusetts, dated January, 1889, is an unusually interesting volume. It is devoted almost entirely to what may be called the physical or mechanical condition of the railroads of the State, very little space being devoted to the traffic on its lines. It begins, without precursory remarks, with the subject of heating and lighting cars. Heating cars is discussed at considerable length, and the Commissioners give what is perhaps as concise a summary of the state of the art as can now be found in print.

In 1882 the Legislature of Massachusetts enacted a law requiring that passenger cars shall be provided with such safeguards for protection against fire as may be approved by the Commissioners. In 1887 this law was modified so as to prohibit the use of common stoves, and requiring that no other method of heating shall be used without the approval of the Commissioners. The Board was also instructed to investigate and report on the subject. In 1887 a circular was issued in which the adoption of a system of heating by steam from the locomotive was recommended, or at least of such heating appliances as can be used in connection with or readily converted into the system. On May 1, of last year, the Board reported that "the difficulties have not all been surmounted, that there is trouble from the leakage of steam and from the freezing of traps, and

the imperfect action of reducing valves on the engine, yet it is believed that heating by steam from the locomotive is not only practicable and conducive to the comfort and safety of passengers, but is also economical, and should be generally adopted by the first day of October, 1889." Last year, however, the Legislature instructed the Commissioners to make further report on the subject, and continue in force approvals of methods of heating already granted. In view of this they continued their investigations and encountered the ordinary objection, that in case of accident, or from other cause, an engine is detached from a train or unable to supply it with steam, passengers would suffer seriously from cold. This objection the Commissioners, think has very little weight, or, if it has any, it is only an argument in favor of retaining auxiliary heaters in cars, for use in case of failure of the supply of steam from the locomotive.

The objection that there is difficulty in keeping a uniform temperature with steam heat the Commissioners also think has little weight. In the light, or rather in the heat of some past experience, we are inclined to think the Commissioners have considered this objection more coolly than some passengers have during the recent mild weather. Reports reach us of parboiled travelers who were subjected to the temperatures of a Turkish bath, either through defects of the steam-heating apparatus or the neglect or ignorance of the attendants. It is obvious that with the increasing complication of the appliances which are each year added to modern railroad trains, that those who run them must be specially qualified for their duties. It is generally recognized that the sense of color and of sight at a distance, of hearing and of smell varies in acuteness within very wide limitations, and on our best lines of railroad candidates for positions as train hands are examined with reference to their qualifications in some of these particulars before they are appointed. It is not so generally recognized that the sense of temperature also varies greatly in acuteness in different persons. The Massachusetts Commissioners recommend that "a good and good-sized thermometer be placed in every car." It would be an excellent plan to test the sense of temperature of applicants for positions as attendants in passenger cars, but especially porters in sleeping cars. Such an examination could be made in any bath-room where there is hot and cold water, or with a tea-kettle and a pitcher of cold water. It would probably be found that many persons can only distinguish great differences in temperature. From observation and experience almost any traveler would infer that very many brakemen, porters, and conductors cannot distinguish the difference between 50 and 90 degrees of heat in the atmosphere of a car. With steam-heated cars the passengers are at the mercy of the attendants, who may alternately roast and freeze those under their care or reduce them to a condition of semi-asphyxiation, by shutting out all fresh air. The two subjects of ventilation and heating necessarily go together, and it will be impossible to maintain a uniform temperature and pure air in cars unless the attendants have some knowledge of the construction of the apparatus they have under their control and of the principles of ventilation. It must be remembered that a very large proportion of mankind still has an aversion for clean water and fresh air, and that this barrier of ignorance always stands as an obstacle in the way of keeping the air in cars reasonably pure. The Massachusetts Commissioners say that "the present lack of uniformity in temperature (in steam-heated cars) is due partly to the fact that the employés have not yet learned to use the existing appliances for regulation to the best advantage, and partly to the failure to provide means for restricting the circulation to a portion only of the piping whenever it is desirable to do so." Even with abundant means of regulating the heat cars will not be properly warmed and ventilated unless the trainmen are properly instructed and rigidly disciplined in its use.

To the objection of the cost of heating with steam from the locomotive, the Commissioners express the belief that it will prove to be more economical than other methods of heating. Whether it is or not will perhaps have very little weight in the consideration of the question, as the public will not consent to have persons burned to death occasionally because railroad companies can save money by assuming that risk.

Another objection to heating with steam from the locomotive which is considered by the Commissioners, is that it is more dangerous than some of the individual heater systems. To throw light on this question, the Commissioners had a series of experiments made to ascertain the effect of the accidental discharge into a car of steam from the heater pipes. Pipes were arranged with valves so that they could be opened at once to their full extent. Even with a pressure of 80 lbs. it was found that there was no danger of being scalded, unless a person's body was in the direct line of the escaping steam and within from three to five feet of the orifice.

The Commissioners conclude this portion of their report with the remark that "locomotive steam-heating has now acquired such a foothold that it will probably come gradually into general use without compulsory legislation."

CAR WHEELS.

An important element, the Commissioners say, in the disaster which occurred at Bradford, on the Boston & Maine Railroad, in January, 1888, was the breaking of a cast-iron wheel. This fact has led them to investigate the relative safety and cost of chilled cast-iron and steel-tired wheels for passenger trains, and the special report on this accident contains a good deal of testimony and data bearing on this question. Much of this is of a contradictory character, and the inquirer for information will be quite sure to be in a confused state of mind with reference to the relative cost and safety of cast-iron and steel-tired wheels, when he has finished reading the report. In fact, the attitude of the Commissioners in relation to it seems to be like that of a gentleman in a Southern city "before the war" who was asked a question about slavery, and answered that he knew little or nothing about it, and was always afraid to investigate it for fear that in doing so he would get into a terrible state of excitement. The Commissioners, after carrying their investigations to a certain point, seemed to have entertained a somewhat similar apprehension to our Southern friend. They say that their "investigation showed that in purchasing cast-iron wheels it is necessary that they should be required to conform to stringent specifications and should be subjected to searching tests," which is undoubtedly a sound conclusion; but their observation that "statistics *seem* to prove that the best of steel-tired wheels are safer than the best of cast-iron wheels," does not seem to have quite as firm a foundation to rest on. Statistics which only *seem* to prove are a very uncertain and sometimes dangerous reliance. The Commissioners quote letters from prominent railroad men with reference to this subject. Mr. Ely, of Altoona, re-

ports an average of one broken cast-iron wheel in a thousand under passenger cars in 1887. Mr. Wallace, of the Grand Trunk, reports two accidents from the failure of wrought-iron wheels, with 3,188 wheels in service. Whether this covers a period of one year or more, or whether the fracture of tires is included is not stated. Mr. Rhodes reports 296 steel-tired wheels in service and two failures in 1887—one of which derailed a train—or one failure to every 193 wheels, and he also reports 2,680 cast-iron wheels in use under passenger cars, *none of which were removed during* 1887 *on account of being broken.* The Pullman Company report that they have over 11,000 steel-tired wheels in service. They do not give the number of failures of wheels or tires, but say that very few tires have broken in service during the years that such wheels have been used, and that in some cases a car with a broken wheel was able to travel several miles without derailment or damage to the car. The Atchison, Topeka & Santa Fé Railroad report eight failures of steel-tired wheels in 1887. The number in use is not given. The Boston & Maine report 550 steel-tired wheels, in use in 1887 and none broken, and 3,478 chilled wheels, of which 18 were found to be cracked or broken. The Grand Trunk Railway report that 8 per cent. of the cast-iron wheels under passenger cars and 2 per cent. under freight cars were discarded for breakages or cracks during the past year.

Mr. Barr, of the Chicago, Milwaukee & St. Paul Railway, says "My experience, as a matter of record both on this road and on the Pennsylvania road, is that steel-tired wheels are more liable to break than good cast-iron wheels. On the Milwaukee & St. Paul Railway during 1887 we had 25 steel-tired wheels fail from breakage, and 50 cast-iron wheels. These numbers are just about proportionate to the number of steel-tired and cast-iron wheels running. In January, 1888, we had 11 steel-tired and eight cast-iron wheels break."

It will thus be seen that these statistics are very far from being conclusive with reference to the relative safety of cast-iron and steel-tired wheels.

Regarding the relative cost of the wheels the evidence cited by the Commissioners is also ambiguous. Mr. Ely makes an estimate in which he shows that cast-iron wheels which make an average mileage of 42,522 cost 14.5 cents per thousand miles run, whereas steel-tired wheels, with an average of 250,000 miles, cost 24 cents per thousand miles. This he says is more than they have been able to get on the Pennsylvania road. Mr. Wallace reports an average of only 162,000 miles, and this average includes many 43-in. wheels. The Pullman Company report an average mileage of 340,843, chiefly 42-in. wheels, and 335,670 miles for 33-in. wheels.

From these data it will be seen that the testimony quoted by the Commissioners does not "*seem*" to prove much of anything, with reference to the relative safety and economy of steel-tired and cast-iron wheels, excepting that some more conclusive data are needed to guide both the Railroad Commissioners and railroad officers.

The Report before us is full of other interesting matter, but our limit of space for its consideration has been reached and further discussion of it must be relinquished, at least for the present.

RAILROADS AND THEIR EMPLOYÉS.

THE article on the Prevention of Railroad Strikes, by Mr. Charles Francis Adams, which is published in the April number of *Scribner's Magazine*, will doubtless attract much attention from railroad men, not only from the suggestions which it makes in relation to the railroad service, but also from Mr. Adams's position as President of the Union Pacific Company, and from the reputation as a thinker and a writer on railroad matters, which he gained during his long period of service on the Massachusetts Commission. The article itself is mainly a reproduction of a memorandum which Mr. Adams prepared for the Union Pacific Company some three years ago, but which was never acted upon or made public. While drawn up with special reference to the circumstances of that Company, it nevertheless contains much which is applicable to all large corporations.

The organization of the service proposed in this article is intended to do away with the evils resulting from the present shifting and transitory character of the force on most of our roads, and to provide for a permanency and a strictness of discipline which is almost impossible under present conditions. To this end Mr. Adams proposes, on the one hand, to offer such inducements as will prevent the railroad employé from quitting a road for slight cause—or for no cause at all—and, on the other hand, to secure him in his position by taking away the power of arbitrary dismissal, which is now very generally vested in Superintendents and other officers. Incidentally, he believes that this plan would remove much of the friction now existing, and would put an end to trades-unions, by practically depriving them of any reason for existence.

Space will not permit a full summary here, but it may be said that it is the plan in use on the great French railroads, of a permanent service with graduated promotion and gradual increase of pay with length of service, provision being made also for temporary employment, which shall serve as a probationary term and provide an auxiliary force from which appointments shall be made to the permanent service. Incidentally, or rather, perhaps, as a result, he would provide insurance funds for employés and schools of apprenticeship in which young men should be educated for the service.

The main points of this system are that every employé should feel himself secure in his position during good behavior, and also sure of such promotion or increase of pay as his length of service, capacity, and improvement may justify. To modify this French system and bring it more into accordance with American ideas, he proposes to add a council composed of delegates chosen by the employés, who should represent them in their dealings with the company, should act as advisors in all matters in which they are concerned, and should also serve, in connection with officers of the company, as a tribunal for the trial of all offenders against the rules of the road; and he would give to every one a right of appeal to this tribunal before he could be dismissed from the service. He would also, in working out the details of his plan, provide for somewhat more freedom of action than the French system allows, believing this to be necessary in order to deal properly with the class of men here employed, who are usually much more independent and accustomed to think and act for themselves than the French employés.

Undoubtedly many arguments can be presented in favor of such a system, and it is at least worth careful study. A partly similar organization has for years been in use by one or two of the larger Eastern Companies, with results which must be admitted to be generally good. At the same time, it must be remembered that there is always

great difficulty in making such a system sufficiently elastic, and that there is always danger of its becoming a mere beaureaucracy, the inevitable tendency of which is to suppress exceptional ability and to keep everything at a uniform level of mediocrity.

A railroad company, or its executive head, should be left free to recognize ability and to reward it by promotion out of the usual course in its own service, and provision should be made against the tendency—which always exists in a permanent force—to become a close corporation, which, whatever jealousies may exist among its individual members, will always unite to oppose exceptional promotion or the appointment of officers from outside its own number. Permanency of service is certainly very much to be desired on our railroads, but how to combine it with the proper degree of freedom of action in appointments is a study which needs and ought to receive careful attention from managers.

In one point Mr. Adams is certainly right, and that is in claiming that proper discipline is not only possible under the proposed conditions, but more easily obtained than at present, and in insisting upon the right of an employé to protection against arbitrary discharge, and to a recognition of the claims upon a company, which he establishes by faithfulness and diligence in any position, high or low. This is essential to any lasting adjustment of the question, and a full recognition of the principle would go far toward improving present relations.

RECLAIMING BARREN LANDS.

ONE of the most notable public works of recent times has been the reclamation of the extensive district known as the Landes of Gascony by French engineers, at whose head was M. Chambrelent. This district, including an area of about 800,000 hectares (1,980,000 acres), had been for centuries regarded as a worthless desert, not only unavailable for agriculture, but extremely unhealthy on account of the malarial exhalations at certain seasons of the year, and of the absence of any supply of good drinking water.

Efforts had been made at various times to improve this district—notably in the early part of the present century—but they had all proved disastrous failures, and it was not without much difficulty that M. Chambrelent secured a trial for his plan.

The general surface of the Landes is nearly level and the soil was a silicious sand, entirely destitute of any mixture of lime or clay, resting upon a subsoil of clay or hardpan impervious to water. The rains of winter did not drain off, but remained in swampy pools, filling the slight irregularities of the plain; and these surface waters evaporated under the sun of early summer, leaving the sandy soil entirely dry under the heat of July and August. What little vegetation could start up around the pools in the early spring was dried and burned up in the summer, the roots finding no reserve of moisture in the loose sand, and being unable to penetrate the hard clay below.

The methods adopted to reclaim this district, though only selected after a careful study extending over several years, were really very simple. They consisted first, of the establishment of a system of surface drainage by means of shallow ditches, intended not so much to draw off all the rain water as to equalize its distribution; and second, of the planting of forests of pine-trees, which are known to grow well in a sandy soil.

The work proceeded slowly, of course, being at first largely experimental in its nature. It was found, however, as it advanced, that the trees from the seed first planted grew and throve in an unexpected way, while their spreading roots not only consolidated the loose sand and held in it a reserve of moisture—which had formerly been evaporated, but which now served to supply the growing trees—but also, apparently, broke up and penetrated the underlying hardpan, drawing nourishment from it also as the trees increased in size.

So successful were the first experiments that the work was pushed forward faster and faster until the whole district is now reclaimed, and from a worthless desert has become one of the most prosperous parts of France.

Two subordinate but still important works were found necessary. The first was to provide a supply of drinking water for the men and animals engaged in the work and for the population which was expected to follow its completion. This problem, fortunately, was easily solved by sinking wells to a moderate depth: these wells yielded a supply of water of good quality and sufficient in quantity for all requirements.

The second was to prevent the continued encroachment on the reclaimed lands of the shifting sand-dunes which formed on the sea-shore of the district, and which, under the influence of the prevailing winds, were constantly moving inland. After much study and experiment this was accomplished by the use of what might be called temporary sand-fences, by which the sand-dunes were not only checked in their movement, but also, as it were, reversed and made to form a barrier against any further encroachments from the sea.

Financially the operation has been highly successful. The Landes were nearly all owned by the surrounding *Communes* (or townships), having too little value to invite purchase or settlement by private owners. The funds for beginning the work were provided by these *Communes*, under a special law; as it advanced the reclaimed land was sold at prices which not only paid for the work but provided funds for building roads and school houses and for making many other improvements.

The district is now intersected by several railroad lines, which find a considerable traffic in carrying the lumber which is yearly cut from the growing plantations. Not only is lumber supplied, but large quantities of charcoal and firewood—both scarce articles in France—are shipped to Paris and other cities, and many thousand ties are yearly supplied to the railroads. It need hardly be said that the cutting of trees is carefully regulated and provision is made for renewing the growth.

The Landes under this treatment have not only become valuable, but their sanitary character has been completely changed. The few inhabitants were formerly constant sufferers from malarial diseases, but now, with a largely increased population, such diseases have disappeared, and the average health of the whole district is considerably above that of the average of all the rural *Communes* of France. This result is ascribed by the local physicians to the good surface drainage, the sea winds, and the neighborhood of the pine forests, as well as to the usually good sanitary condition of the dwellings, resulting from the general prosperity of the people.

The whole history of the reclamation of the Landes is worthy of study by engineers in this country, where the time is fast approaching when the increasing value of land will make it profitable to undertake similar operations.

NEW PUBLICATIONS.

CATALOGUE OF THE MINERALS AND WOODS OF THE REGIONS TRAVERSED BY THE LINES OF THE RICHMOND & DANVILLE RAILROAD COMPANY. Richmond, Va.; issued by the Company.

This is a catalogue of the exhibits made by the Richmond & Danville Railroad Company at Atlanta, 1881; Boston, 1882; Denver, 1883; New Orleans, 1884; Atlanta again, 1887, and at Richmond in 1889. These exhibits include specimens of the mineral products found on or near the company's lines in Virginia, North Carolina, South Carolina, and Georgia, and of the various kinds of woods from trees growing in the same districts.

The minerals cover a wide range, including ores of gold, copper, iron, manganese, tin, and many less known metals; coal, mica, building stone of many kinds, and a long list of other useful minerals. Most of these deposits are still but little developed.

The list of native woods shows a great variety of useful and valuable timber. Such an exhibit is a very valuable one, both to the railroad and to the community which it serves, and the Richmond & Danville Company deserves credit for the care with which its collections were made.

THE COAL TRADE: BY FREDERICK E. SAWARD. New York; published by the Author.

This is the sixteenth issue of a very valuable statistical annual, the only one, in fact, which gives the coal production and distribution of the United States with anything approaching to completeness, or in convenient form. Entire accuracy or completeness is, unfortunately, not possible under our present system, but Mr. Saward's long experience as Editor of the *Coal Trade Journal* has given him a thorough knowledge of the trade and of the sources from which the most reliable information is to be obtained—a very great advantage in preparing a manual of this kind.

The coal industry is of so much importance in itself, and is so closly related not only to all other industries, but also to daily household life, that its condition and development must be of interest to almost every one; and nowhere can it be better studied than in the successive issues of this annual. For the use of any one engaged in the trade as operator or dealer it seems almost indispensable.

STEAM: ITS GENERATION AND USE. New York; issued by the Babcock & Wilcox Company.

This is a new edition of the catalogue of the manufactures of the Babcock & Wilcox Company, and deserves especial mention for the care with which it has been prepared and the elegance of its mechanical execution. It is, of course, intended to set forth the merits of the Babcock & Wilcox boiler, but it contains also much useful and valuable information on steam, combustion, and kindred topics. The illustrations are of the best, while the printing and binding of the book are admirable specimens of American work.

A TREATISE ON HYDRAULICS: BY MANSFIELD MERRIMAN, PROFESSOR OF CIVIL ENGINEERING IN LEHIGH UNIVERSITY. New York; John Wiley & Sons, No. 15 Astor Place (price, $3.50).

In this book Professor Merriman has undertaken to give a summary of our present knowledge on this subject, which shall at once be comprehensive and compact in form, and which may serve as a book of reference for engineers as well as a text-book for students. In these objects he has succeeded very well, and his book will not only be a valuable addition to the literature of the subject, but will doubtless become a standard work. It not only gives the accepted formulæ with some new ones and many modifications, but also the reasons for these formulæ and some account of the experiments upon which they are based.

The different chapter headings include: Hydrostatics; Theoretical Hydraulics; Flow through Orifices; Flow over Weirs; Flow through Tubes; Flow in Pipes; Flow in Conduits and Canals; Flow in Rivers; Measurement of Water-power; Dynamic Pressure of Flowing Water; Hydraulic Motors, and Naval Hydromechanics.

It is accompanied by a number of tables, calculated from the formulæ given, which are very convenient for reference. It is written in the clear and exact style which we are accustomed to expect from Professor Merriman, and contains little or nothing that can be called superfluous.

OUR RAILROADS: BY HARRY P. ROBINSON. *Being a Presentation of Facts and Figures showing the Value, Earnings, Profits, and Present Condition of the Railroads of Minnesota and the Northwest.* St. Paul, Minn.; Published by the Author.

This pamphlet, the author of which is editor of the *Northwestern Railroader*, presents a great array of statistics, the object of which is, apparently, to show that the railroads of Minnesota and the adjoining States are generally earning, under existing conditions, much less than a fair return upon the capital invested in them. He illustrates, in a somewhat striking way, the great reduction in rates which has taken place during the past few years, with some of the causes which has tended to produce this result, and argues against the policy of any further reduction. According to Mr. Robinson's figures, while Minnesota railroads are, on the average, capitalized at a somewhat lower figure than those of most of the States, their earnings per mile, both gross and net, are also considerably below the average for the whole country. Whatever opinion we may have as to the justice of his conclusions, we must admit that the author has presented his arguments both clearly and forcibly, and his pamphlet is well worth careful reading.

A GENERAL FORMULA FOR THE UNIFORM FLOW OF WATERS IN RIVERS AND OTHER CHANNELS: BY E. GANGUILLET AND W. R. KUTTER; TRANSLATED BY RUDOLPH HERING AND JOHN C. TRAUTWINE, JR. *With numerous additions, including Tables, Diagrams, and the Elements of over* 1,200 *Gaugings of Rivers, Small Channels, and Pipes.* New York; John Wiley & Sons, No. 15 Astor Place (price, $4).

This treatise was translated some eight years ago, and as since then the correctness of the formula has led to its very general adoption by Hydraulicians, a demand for such a book as this, has been, in the opinions of the translators, created which has led to the present publication in octavo form, containing not only the translation of the original treatise, but an addition in the shape of appendices which in many respects are of more value even than the main part of the book.

Part I contains a short historical account of the different formulas that have been used, down to the establishment of Bazin's formula, based upon the measurement of Eu-

ropean waterways of small area and steep slopes, and Humphrey's and Abbot's new American formula, based principally upon gaugings of the Mississippi River.

The manner in which these two formulæ fail, as a general formula applicable to all probable conditions, is clearly shown, and the problem of a generally applicable formula is clearly stated.

Part II is devoted to a development of a general formula. Comparison of the results obtained by Bazin, Humphrey and Abbott, and the new general formula. Correctness checked by actual gaugings under various circumstances.

This constitutes the book proper. A Supplement of 10 pages contains in concise form most of the essential matter contained in the preceding 93 pages, as to the derivation of the formula.

Appendices give, first, the limitations of the formula, second, some general laws regarding its use, third, coefficient of roughness, fourth, method of computing velocity from the formula, fifth, the construction of diagram and many other points of practical importance. These are followed by about 110 pages of tables to facilitate the use of the Ganguillet and Kutter formula.

The book as a whole is a comprehensive treatise upon the formula that is developed. There is one most excellent feature, aside from the value of its contents, and that is, the free use that has been made of Graphics to bring clearly before the eye the comparative results obtained and show how much of practical work in the use of the formula can be simplified by the use of diagrams and graphic methods. Much of this general use of graphics in this book is undoubtedly due to the translators, who have endeavored to present their subject in as clear and simple a manner as possible, using care not to bury their facts "out of sight under heaps of mathematical rubbish," as is too often the case in books of this class.

TWENTIETH ANNUAL REPORT OF THE MASSACHUSETTS RAILROAD COMMISSIONERS: 1888. Boston, Mass.; State Printers.

The Report of the Massachusetts Railroad Commission this year treats of the usual variety of subjects, and has much to say of the experience gained during the year in continuous heating of passenger trains. The Commissioners now believe that continuous heating by steam from the locomotive has acquired such a foothold that it will probably come into general use.

Other special subjects touched on are grade-crossings, car-wheels, switches and couplers, and there is also an interesting report on the railroad bridges of the State.

STATISTICS OF THE AMERICAN AND FOREIGN IRON TRADES FOR 1888. ANNUAL STATISTICAL REPORT OF THE AMERICAN IRON AND STEEL ASSOCIATION: *Containing Complete Statistics of the American Trade for* 1888, *Compared with* 1887, *and a Brief Review of the Present Condition of the Iron Industry in Foreign Countries.* Philadelphia; Published by the American Iron & Steel Association.

This report, as usual, contains full statements of the production of iron ore, pig iron, finished iron and steel in the United States, with tables of prices, values, etc. It is the only publication of the kind in this country giving these statements with an approach to official accuracy, and the long experience of Mr. Swank, Secretary of the Association, in preparing these reports, has enabled him to present the statistics in a very compact and convenient shape. The report is issued this year more promptly than usual, which is an advantage, accompanied only by the slight drawback that, owing to this early publication, the review of the foreign iron trade is briefer than usual.

An interesting appendix gives a list of the new vessels now under construction and authorized for the Navy, with some account of the new guns under construction, the object being to show the demand for steel for Government purposes.

COAL SUPPLY.

(From the *Evening Post.*)

Now and then some man of science bolder than his fellows faces the question, "How long will the coal supply last?" The late Professor Jevons undertook to answer it for England twenty-four years ago, and made himself extremely unpopular for a time. According to his computation, the supply would be exhausted in 110 years. Sir William Armstrong had previously calculated that all the coal within 4,000 ft. of the surface would be exhausted in 212 years from 1861. Professor Marshall of Yorkshire College examined the question in 1878, and confirmed in substance the conclusions of Professor Jevons, but added some facts to show that a very slight difficulty in the procuring of coal, causing an enhancement of price, would revolutionize British industry and cause dire distress to her teeming population. And now Mr. Price Williams has presented a paper to the Royal Statistical Society in which he estimates the duration of the principal English coal fields at the present and prospective rate of consumption, thus:

	No. of Years.
Northumberland and Durham	94
South Wales	79
" " Eastern division	46
Lancashire and Cheshire	74
Yorkshire, Derbyshire and Nottingham	90
Warwickshire	53
Denbighshire and Flintshire	250
Scotland	92
United Kingdom	102

Although coal has been used more or less as fuel in Great Britain from a very early period, perhaps from the time of the Roman occupation, the total production of the United Kingdom did not reach 10,000,000 tons per annum until the beginning of the present century. We may say, therefore, that no perceptible draft had been made upon the stock prior to the year 1800. During the next 50 years the increase of consumption was moderate, reaching only 52,000,000 tons in the year 1852. From that time onward the rise has been by leaps and bounds. In 1866 the output was 101,000,000 tons, in 1883 it had reached 160,000,000 tons, and it has increased since that time at the rate of 1¾ per cent. per annum. If Mr. Price Williams's computations are to be accepted as correct—and they coincide remarkably with those of Jevons and Marshall—it will appear that a period of 191 years, beginning with the year 1800, will have sufficed to disembowel the United Kingdom of that element of wealth and power to which she owes her present greatness, and in comparison with which all other elements are trivial and insignificant. When her coal is gone, there will be no more Great Britain. Empire will pass out of her hands into those of countries better supplied with this indispensable article, and so, according to our present knowledge, will empire shift her seat through coming ages from one country to another until all are reduced to the common level of want, for all coal-beds are exhaustible. The Reading Railroad Company, which owns or controls one-third of the anthracite deposits of Pennsylvania, has estimated the duration of its supply at about 150 years, and has deemed it necessary to create a sinking fund to meet the exigency.

Up to this time nobody has ventured to say what fate will overtake the human race when all the coal is consumed and gone. Of course economies will be introduced. More power will be got out of a given amount of coal.

Great economies have been introduced, but the annual draft on the mines increases from year to year. The annual draft increased in England at the rate of 3 per cent. per annum from 1865 to 1875. It has been reduced to 1¾ per cent., but it is an increase still. More tons are required every year than the year before. Natural gas, petroleum, and shale, where they exist, will serve the turn to eke out the coal supply, but these, too, are exhaustible. They are all scraps of the sun's radiant energy, imprisoned by chance or by Divine Providence in the earth's shell. They are, all told, but a fraction of the radiant energy which the sun pours over the earth every day, and this is an inappreciable fraction of what the sun pours into illimitable space. Will the genius of man ever contrive means to capture and impound the fraction which our globe intercepts as it rushes through sun-lit space? Here is the greatest question ever presented to the human species, for unless this feat be accomplished, population must eventually be reduced to the number who can be supplied with fuel from the cultivation of trees. Power may be obtained from falling water and from the ocean tides, and this may be converted into heat; but it is a pitiful and poor substitute for coal, and would not begin to maintain the world's present population in the present scale of civilization and comfort.

The prize of greatest magnitude ever offered to men of science—the honor of rescuing the entire race from misery unspeakable—awaits the man or men who shall grasp, and hold, and render serviceable the rays of the all-powerful sun. No one can say that this problem will not be solved. We now know that light and heat are manifestations of one and the same thing. We know that light is abundant and superabundant. We do not know whether it can be concentrated and converted into heat so as to take the place of coal in the economies of the world. According to our present knowledge, we are living in the world's golden age. Those who went before us knew not the civilization that we enjoy, because they knew not the uses of coal. Those who follow us, after the coal is burned up and gone, will have to resign that civilization—a much harder fate than never to have known it—unless the great sun problem can be solved. Nobody who is now alive need concern himself with that hard destiny, but in the history of the planet, even the written history, the age of coal will be comparatively a short one.

THE DEVELOPMENT OF THE MODERN HIGH-POWER RIFLED CANNON.

By Lieutenant Joseph M. Califf, Third U. S. Artillery.

(*Continued from page 161.*)

IV.—EARLY GUN CONSTRUCTION.

When at Kinburn, on October 17, 1855, the round shot from the Russian batteries broke to pieces or rattled harmlessly against the iron plating of the three French armor-clad floating batteries, they sounded the doom of smooth-bore ordnance. From that hour to the present the battle between the gun and the armor-plate has been going on with fluctuating advantage. In the contest the 24-pounder of the Russian has grown to the 120-ton monster of Krupp; and the 4½ in. of wrought-iron armor of the *Devastation* has increased to the 22 in. of steel of the *Duilió*, and the battle is still on, but with strong indications that the final victory will remain with the rifle, where it is to-day.

Before the necessity of rifled ordnance had been so thoroughly demonstrated at Kinburn, experiments in this direction had already begun. About the time when the adoption of rifled small-arms for the military service had been decided upon (1840), the question of rifled cannon was taken up by artillerists. In 1846, Major Cavalli, a Sardinian officer, invented a breech-loading rifled cannon. It was of cast iron, 16 calibers in length, 66 cwt., with a caliber of a little over 6 in. Two deep spiral grooves, with a twist equal to twice the length of the bore, served to give rotation to the projectile. In the same year Baron Wahrendorf invented another breech-loading rifle of about the same caliber, of which no details are given.

Neither of these systems seem to have gained a foothold, and are mentioned as the first decided steps looking toward the improvement of heavy guns. At this time the heavy ordnance of the period were 32, 42, and 68-pounders, or pieces corresponding to about these calibers.

In 1854 Mr. William Armstrong submitted to the English War Minister proposals for a rifled breech-loading field gun. The gun was completed the following year, and after a long series of experiments, extending over several years, was finally adopted into the English service in 1859.

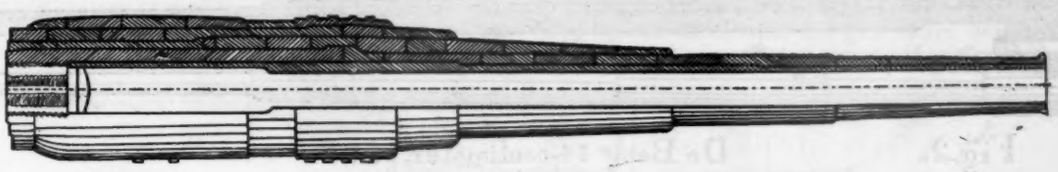


Fig. 1.

The first rifled ordnance, however, to receive trial in actual warfare were the so-called Lancaster guns, in the Crimea, in 1854–55. These were 68-pounder cast-iron pieces, rifled on Mr. Lancaster's system, and strengthened with bands of wrought iron. Rotation was secured by giving the bore the form of a twisted ellipse, the projectile, of course, having a corresponding shape. The spiral made one turn in four times the length of the bore, with the greater axis in a vertical plane at the muzzle section and becoming horizontal at the breech section.

The English experiments with these guns in the Crimea were not satisfactory. They failed in the very direction wherein rifled guns are supposed to possess advantages over smooth-bore pieces—accuracy and penetration. At Bormasund the *Edinburgh* attempted to breach masonry at 480 yards. The firing was wild, and the 100-pound projectiles had no effect upon the granite walls.

V.—THE ENGLISH SYSTEM.

The Armstrong gun just alluded to was the first venture in the direction of "built-up" rifled artillery, which has to-day become the almost universal method of gun construction.

The first guns made by Armstrong were composed wholly of wrought iron. The material in long bars, varying in section with the size of the gun, was coiled into spiral tubes two to three feet in length and welded by forging, the tubes themselves being afterward united end to end by welded joints. Behind the trunnions and over the seat of the charge two additional layers of metal were applied. But to obtain longitudinal strength and to sustain the backward thrust on the breech, the second layer was made of an iron slab bent in cylindrical form and welded at the edges, the fiber of the iron being in the direction of the length.

The defects of this method of construction soon became apparent. Small cracks or defective welds would often make their appearance after a few rounds, the welded edges of the spiral sometimes pulled apart, while the repealed shock of discharge had a tendency to produce permanent "set" in the metal. This led to the adoption of what is known as the Fraser modification of the Armstrong system—the substitution of a thin steel lining for the wrought-iron inner tube, surrounded by successive layers of wrought-iron coils or cylinders, the number increasing with the caliber of the gun. The details of con-

struction in the English system—Woolwich and Armstrong—have varied somewhat at different periods, but essentially the method of "building up" the gun has been the same—the shrinking upon an inner coil of wrought iron or tube of steel, forming the bore of hollow cylinders of wrought iron, varying in number with the size of the piece. In guns of latest construction steel only is employed. Fig. 1 is an example of this construction.

In this principle of *shrinkage* may be said to lie the possibilities of the high-power rifle, and it deserves a word of explanation. In a mass of solid, homogeneous metal, as the body of a cast gun, when subjected to sudden and severe pressure, like the explosion of a charge of gunpowder, the metal immediately surrounding the bore is called upon to bear the brunt of the strain, and before the reserve strength of the outer portions can be brought up to its assistance, the elastic limit is passed and rupture takes place. Hence, in guns of this character, beyond a very moderate limit, no additional thickness of metal adds to their strength.

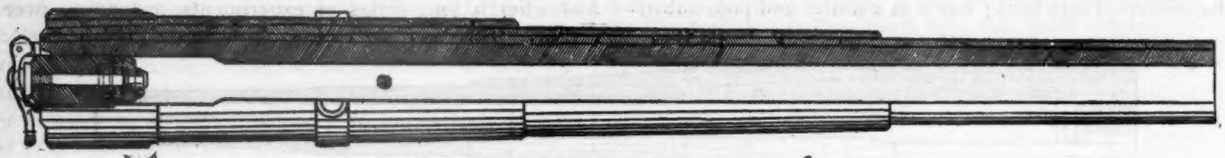


Fig. 2. De Bang 34-centimeter gun.

With a built-up gun the conditions are different. The inner tube, forming the bore, is of sufficient thickness to bear the first shock of discharge. The second tube or cylinder is carefully bored, so that its interior diameter when cold is slightly smaller than the exterior diameter of the inner tube. A moderate degree of heat will expand this outer tube, so that it can be easily slipped over the inner one. Upon cooling it shrinks and compresses the inner tube, which is then in what is called a state of "initial tension" or compression. The difference in the diameters of the two tubes regulates the degree of compression. The resistance offered by the inner tube causes the outer one to stretch somewhat in cooling, which is then in a state of extension. If, now, we shrink upon these two tubes a third, in the same manner, a strain of compression is brought upon the second, the degree of which will be measured by its compression minus its previous extension. Were a fourth and a fifth tube to be shrunk on in the same way, the same strains would be brought into play, the compression of the inner tube would be greater than the second, the second than the third, and so on. The last layer would be under the strain of extension only.

A gun whose metal is in this state of tension is in condition to transmit very quickly strains from the inner to the outer coils, thus bringing into play the entire strength of the metal. Especially with slow-burning powders, can this aggregate strength of the gun be brought to bear to resist rupture. With the inner tube or layer of metal in a state of initial tension, it can endure without rupture a strain quite double that of its normal elastic limit.

It might be mentioned here that the two English systems of gun construction—known as the Woolwich and Elswick—follow essentially the same lines; the former being the works of the Royal Gun Factory, the latter those of Sir William Armstrong.

Following closely in the lead of Armstrong, Joseph Whitworth, an English metallurgist, began, toward the end of the fifties, the construction of rifled breech-loading ordnance. Instead, however, of employing wrought iron he used forged cast steel; but in his manner of building up his guns followed the general methods of Armstrong. It is now a well-defined system, differing in several important particulars from the methods employed at Woolwich and Elswick. The steel of which his guns are made instead of being forged in the usual way, is, while in a semi-fluid state, compressed by powerful hydraulic machinery. Hydraulic pressure is likewise employed to assemble the parts. The inner tube has a slight taper toward the breech, and over this is forced the first hoop—the degree of tension being determined, of course, by the amount of taper. A second, a third, and in the larger calibers, a fourth hoop, formed like the first, is forced on. The last hoop carries the trunnions.

The advantages claimed for the Whitworth method of forging by compression are that it leaves the metal with a more uniform molecular structure, that the solidification of the metal is more perfect, and the mass more homogeneous throughout than where the ingot is subjected to long-continued and probably unequal hammering at different points. Very likely the great care exercised in the selection of the metal and in its manipulation during the process of casting, have quite as much to do with the high quality of the metal as this special method of forging. At any rate its superiority is not undisputed among metallurgists.

To Whitworth belongs the credit of having first demonstrated the ability of rifled projectiles of moderate caliber to pierce armor-plates of considerable thickness. As early as 1860 a Whitworth gun, with an 80-pound solid steel shot, perforated for the first time a 4.72-in. plate, and later, with his 7-in. 7½-ton gun and a 150-pound shell, he perforated the so-called *Warrior* target (4.49 in. of wrought iron backed by 18 in. of teak). Whitworth compensated for the small caliber of his shot by increasing their length (three calibers, which at that time was an unusual length), and by making them of steel. As has been said, Whitworth was in advance of his age, and not only this, it may be added that the deserved success he has since obtained has been in spite of the powerful opposition or competition of both Armstrong and the Woolwich people. The English Government would have saved itself millions of pounds had it, in 1859–60, followed the lead of Whitworth with his steel rather than that of Armstrong with his wrought iron.

VI.—FRENCH SYSTEM.

The French Government began the construction of rifled guns in 1855, upon the plan, as has been stated in a previous article, of utilizing its cast-iron ordnance. The first essay was with cast-iron muzzle-loading pieces, unbanded, of about the caliber of a 32-pounder. The results obtained were not satisfactory, and four years later two 6.3-in. all-steel, banded, breech-loading experimental guns were constructed. The first experiments with these guns were highly satisfactory, but later the attempt to use excessive charges of quick-burning powder brought them to grief, discredited steel as a gun metal, and confirmed the belief in cast iron.

From 1860 to 1875 France devoted her attention to cast-iron guns, reinforced in various ways with steel hoops and a steel lining for the bore. At the latter date all-steel built-up guns were constructed, and since that time steel has monopolized the field.

The French heavy guns are built up of a hammered steel tube and four rows of steel hoops. In the 34-cm. gun, the first row extends the whole length of the piece; the second, to the middle of the chase; the third, to in front of the trunnions, while the fourth is made up of three breech hoops and a trunnion ring. To secure additional longitudinal strength the hoops are made with a slight double-taper, as shown in the accompanying cut (fig. 2), in which, however, the taper is considerably exaggerated.

In France, open-hearth steel is used in gun construction. The rough forgings for the tubes and hoops are procured from private foundries, and assembled at the Government works at Creuzot and Saint-Chamond.

(TO BE CONTINUED.)

THE GAGNIERES VIADUCT.

(From the *Revue Generale des Chemins de Fer.*)

NEAR the Gagnieres station on the single-track line from Pouzin to Alais, the valley of the little river Gagnieres is crossed by a masonry viaduct, the piers of which are on land belonging to the Gagnieres Coal Company.

This viaduct was built in 1871 and consists of 13 arches each of 12 meters (39.37 ft.) span, the maximum height being 24 meters (78.74 ft.); the total length is 215 meters (704.20 ft.), on a curve of 300 meters (984 ft.) radius. At that point there is a uniform grade of 1 per cent.

In consequence of sinking in the foundations of some of the arches, shown by the appearance of cracks in the masonry, since the working of the coal-mines began in 1879, the Paris, Lyons & Mediterranean Railroad Company decided to abandon the existing viaduct, the safety of which was threatened by the subterranean working of the mines.

To replace it a new viaduct has been built having a total length of 167 meters (547.76 ft.) between the abutments, with three independent spans, each having 52 meters (170.56 ft.) opening between the masonry piers or abutments. These three spans are all alike in length and in all their details.

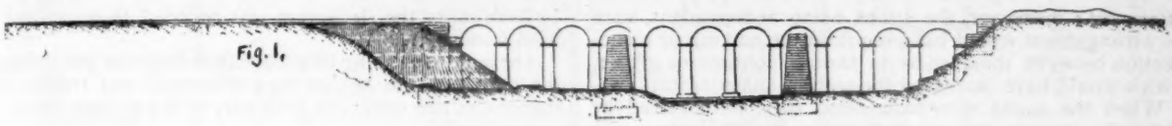


Fig. 1.

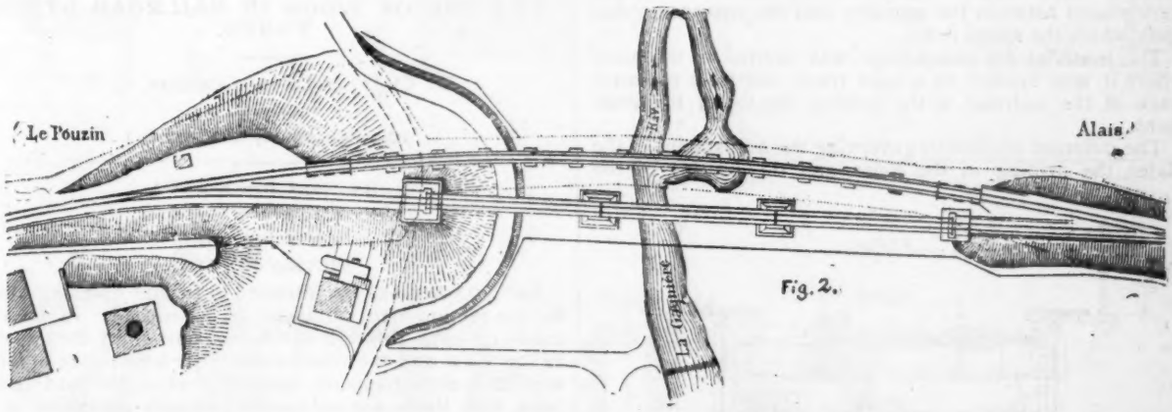


Fig. 2.

The new viaduct is above the old one; it is on a straight line, following the chord of the arc described by the old bridge.

The new structure is a deck-bridge, carrying the floor on the upper chord; the depths of the trusses is 3.900 meters (12.8 ft.) and they are spaced 3.550 meters (11.64 ft.) between centers. They rest upon two piers and upon the two abutments, the surface of the masonry being 4.114 meters (13.5 ft.) below the top of the rail.

The piers and abutments are of stone in regular courses, with a large area at top, the surface of the masonry extending 1 meter (3.28 ft.) in each direction beyond the seats for the trusses; all are built with a batter of 1 in 10 on all faces, and rest on a bed of beton, which is founded on the bed-rock and extends at least a meter in every direction beyond the lowest course of stone.

Under these conditions, in case any movement of the piers or abutments should take place, it will be easy to find a remedy, by taking advantage of the large area provided in the foundations.

The metallic spans are also arranged in such a way that they can be adjusted in case of any sinking of the masonry. Each span, being independent of the others, can be raised at either or both ends to counteract any inequalities resulting from possible settlement of a pier.

The girders of the three spans are supported at each end on cast-iron seats or sockets resting on steel rollers, by which the weight is distributed evenly over the pier. Moreover, the construction of these seats is such that they can be raised, if necessary.

In the accompanying illustrations fig. 1 is an elevation of the old viaduct, showing also the piers and abutments of the new bridge; fig. 2 is a plan showing the location of the old and the new viaducts; fig. 3 is an elevation; fig. 4, a plan of one span of the new viaduct; fig. 5 is a cross-section of one of the spans on a larger scale.

Each of the spans is composed of two simple lattice girders joined above by the floor girders and below by counterbracing. The vertical cross-stays also connect the girders.

Longitudinal strips riveted to the girders and connecting them vertically are carried along the whole length of the span under the rails; longitudinal sleepers of oak held in place by angle iron and bolts serve to carry the rails. Iron brackets fixed to the girders at intervals support a hand railing on each side of the track.

On the abutment the truss, which in the rest of the bridge is composed of channel bars outside and plates inside, is replaced by a full panel with channel bars both outside and inside, placed vertically.

In the rest of the span the girders are braced inside by vertical struts composed of plates and angles; outside and below they are joined by a triangular plate and by angles, at the top of the vertical plate.

Triangular plates of iron of 55 kilogrammes weight per square meter riveted to the trusses and to the longitudinal girders, form counterbraces for the bridge floor.

The principal dimensions of each span are as follows:

Clear opening of each span	52.00	meters	(170.5 ft.)
Total length of girders	57.20	"	(187.6 ")
Width of piers at the top	5.50	"	(18.0 ")
Depth of trusses	3.90	"	(12.8 ")
Distance between centers of girders.	3.55	"	(11.6 ")
Length of panels of truss	3.60	"	(11.8 ")
Length of two end panels of truss..	3.40	"	(11.2 ")
Distance between centers of hand-rails	4.50	"	(14.7 ")

All plates and other pieces have finished joints, the edges and faces being either planned or filed. The riveting is very carefully done to secure perfect joints; all that was done in the shop was done with a riveting machine except in certain corners and joints which the machine could not reach. The rivet holes were all drilled in such a way as to correspond exactly. The diameter of all the holes was 1 mm. greater than that of the rivets. Drifting out of holes was forbidden, and when after the plates, angles and joint-plates were put in place the holes did not correspond, they were drilled out by hand. Care was taken that the rivets were uniformly heated.

An allowance of one-quarter of a millimeter was made on the dimension of each piece entering into the span.

Each of the three spans was assembled and riveted in its place on wooden false-work 19 meters in medium height, which was used successively for each of the spans. The line of the road back of the abutment did not permit the putting of the bridge together and the lowering into place

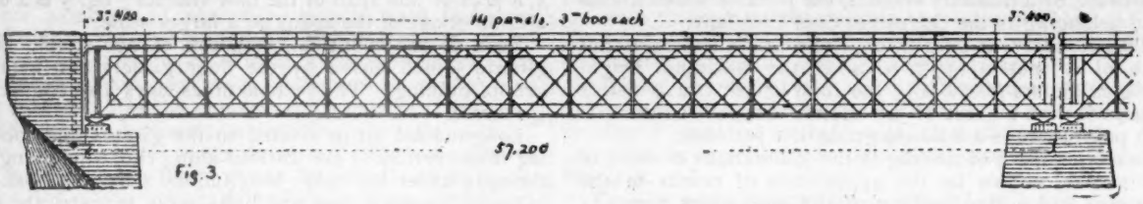


Fig. 3.

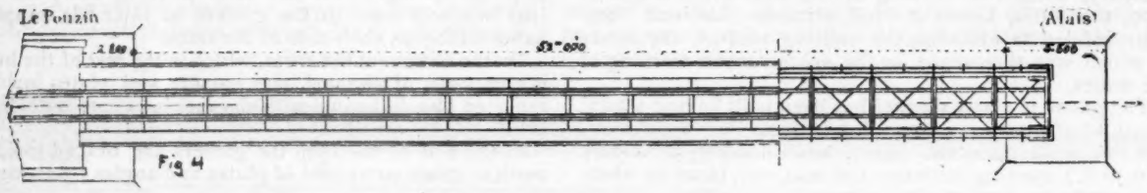


Fig. 4

afterward; moreover, the spans being independent, such an arrangement would have required the making of a connection between them so as to form a continuous girder, which would have increased the weight considerably.

When the spans were completed they were raised by hydraulic presses and the seat-plates on the piers put in position under them. Lead plates 3 mm. in thickness were placed between the masonry and the cast-iron plates upon which the spans rest.

The material for the bridge was carried to the place where it was needed by a spur track laid from the main track of the railroad, at the level of the top of the abutment.

The different conditions governing the adjustment of the plates, the drilling of the holes, and the heating of the

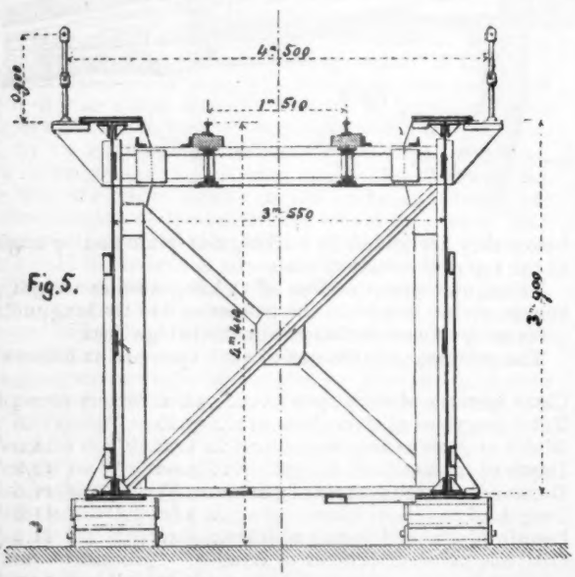


Fig. 5.

rivets at the place of erection were the same as those given above for the work done in the shop.

The work was done by the Société des Forges de Franche-Comte, the price for the superstructure, including transportation, erection, and painting, being 34.85 francs per 100 kilogrammes (3.05 cents per lb.).

The plates, angles, and channel bars used in the superstructure were of mild steel and the rivets of iron.

In testing the bridge a train was used consisting of two locomotives, each weighing 72 tons, and four cars loaded with rails, weighing 62.8 tons, the total weight of the train being 206.8 tons. As, however, this train was slightly longer than the span, it was necessary to deduct the weight upon one axle of the last car, making the actual weight in the test 199 tons.

The test by dead-weight gave a maximum deflection of 43 mm. and an average deflection of 40.9 mm. under the load. The test for a rolling load at a speed of 25 kilom. an hour gave a maximum deflection of 49 mm., and a mean deflection of 47.5 mm. under the passage of the train. In both cases the deflection was reduced to zero after the load was removed.

These results being in accordance with the provisions of the contract, the bridge was accepted, and trains commenced to run over it in February of the present year.

THE USE OF WOOD IN RAILROAD STRUCTURES.

By Charles Davis Jameson, C. E.

(Copyright, 1889, by M. N. Forney.)

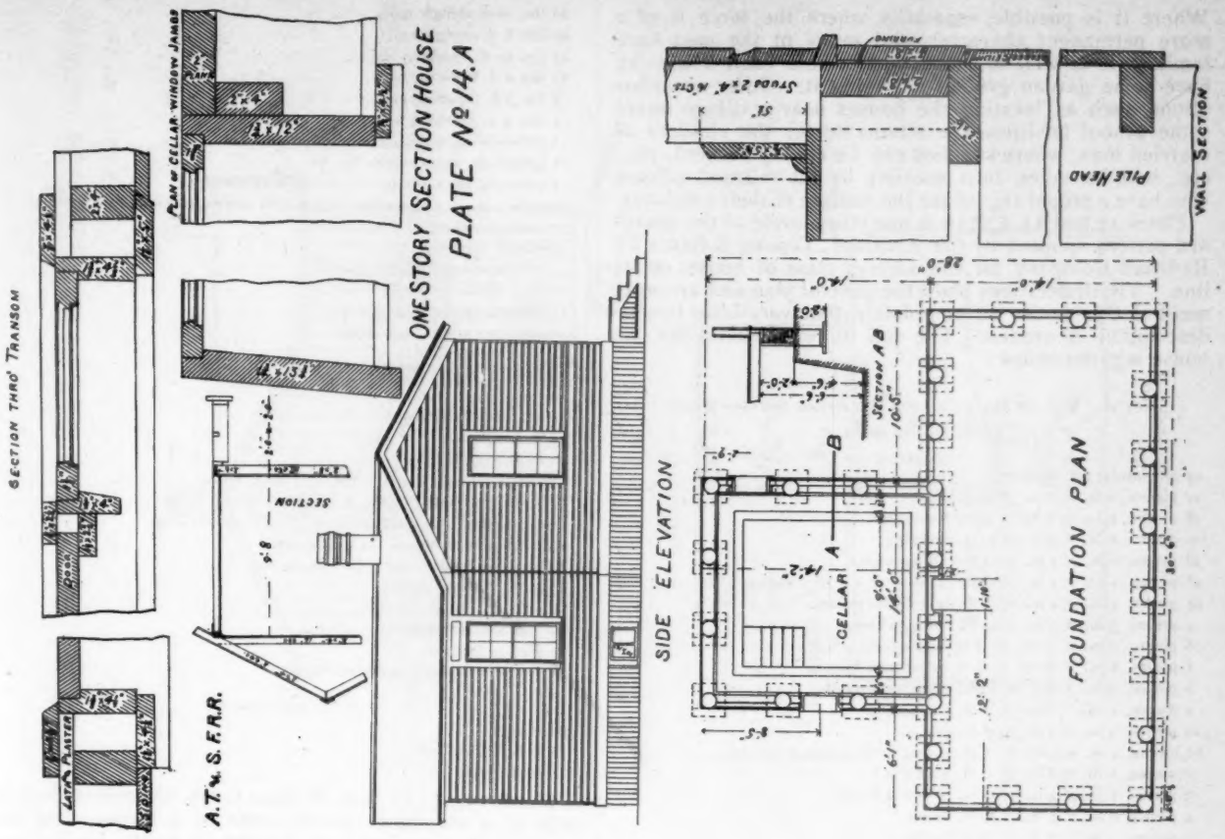
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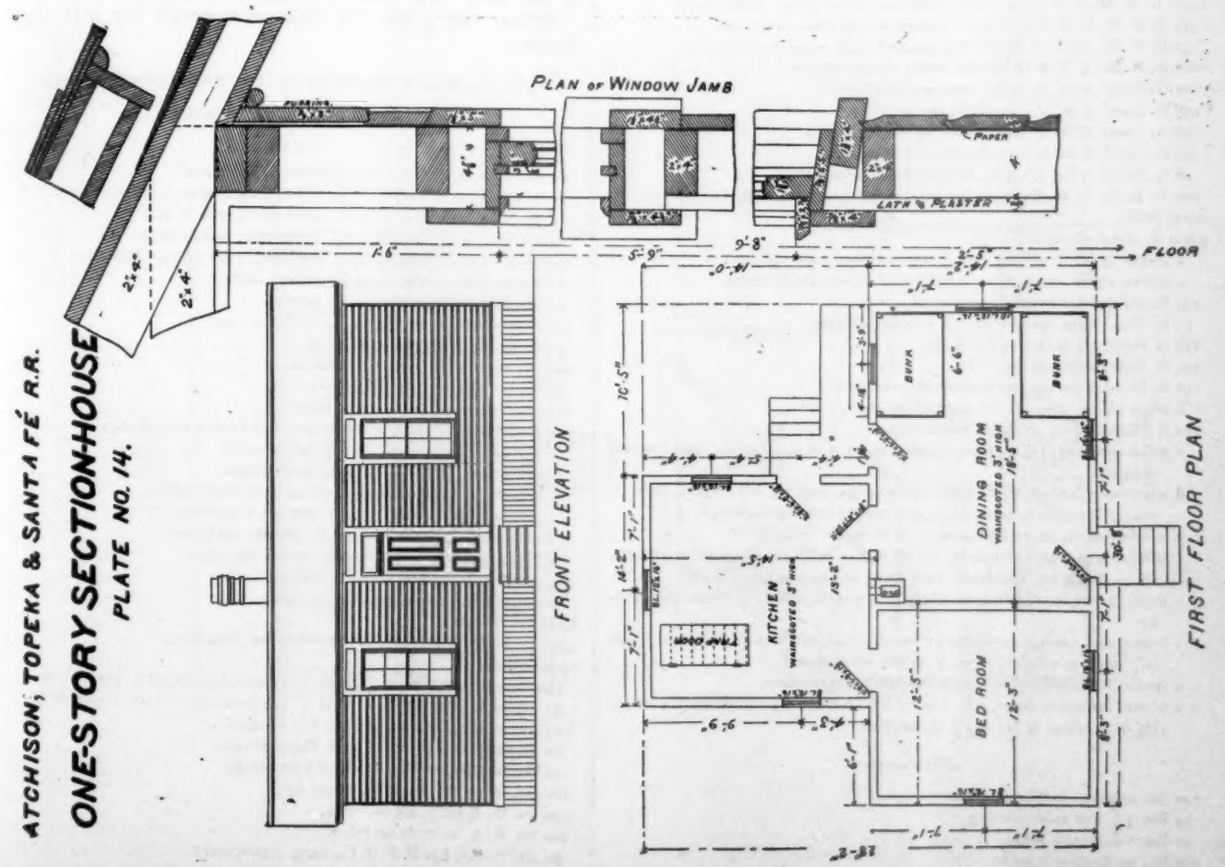
CHAPTER VIII.
SECTION-HOUSES.

SECTION-HOUSES are intended to furnish dwelling-places for the section-men employed on a railroad. In the railroads running through the newer portion of the country, in the West and the Southwest, these houses are a necessity, as it often happens, especially when the road is first built, that there are no dwelling-houses accessible in the vicinity of the line, and some place of shelter must be provided for the working force.

On all railroads it is a convenience in many respects to have these houses. On many of the older roads, running through thickly settled portions of the country, the trackmen have been allowed to live in the small towns and villages on the road, and in houses not belonging to the company. To some extent this practice continues, but many roads have found it expedient to give it up and to provide dwelling-houses on their property and at their own expense. Reasons for this can readily be seen; where the men are scattered through a town or village, it is difficult to collect them when they are needed in a hurry, as, for instance, in case of a washout, a wreck, or other emergencies. Other advantages of the system are so plain that it would be hardly worth while to enumerate them.

The section-house should be so built as to supply a neat, comfortable, and sufficient dwelling-house for the trackmen and for their families, with provision made for a certain number of larger houses, where those men who have not families could be boarded. Their location must, of course, be determined by local considerations. In a thickly settled country it will depend to a considerable extent upon the question of where land can be most easily and cheaply obtained; in a new country, especially where the railroad company owns plenty of land, there will be more liberty of choice. In all cases they should stand upon comparatively high ground, where good drainage can be provided, and where they can be placed without too much crowding.


ONE STORY SECTION HOUSE
PLATE Nº 14.A
A.T.&S.F.R.R.
SIDE ELEVATION
FOUNDATION PLAN
SECTION THRO' TRANSOM
PLAN of CELLAR WINDOW JAMB
WALL SECTION
PILE HEAD
CELLAR
SECTION A B


ATCHISON, TOPEKA & SANTA FÉ R.R.
ONE-STORY SECTION-HOUSE
PLATE NO. 14.
FRONT ELEVATION
PLAN of WINDOW JAMB
FIRST FLOOR PLAN
DINING ROOM
KITCHEN
BED ROOM
BUNK
PAPER
LATH & PLASTER
FLOOR

Where it is possible, especially where the force is of a more permanent character, and many of the men have families, it is well to place them where each house can have some garden ground adjoining it. Other considerations, such as locating the houses near a village where some school facilities are attainable for the children of married men, where supplies can be readily secured, etc., etc., will be taken into account by all railroad officers who have a proper regard for the welfare of their employés.

Plates 14 and 14 *A* show a one-story house of the standard pattern adopted by the Atchison, Topeka & Santa Fé Railroad Company for the smaller class of houses on its line. The illustrations show the general plan and arrangement of this house so completely that very little further description is needed. The full bill of material for this house is given below :

No. 28. Bill of Material for One-Story Section-House.

Plates No. 14 and 14*A*.

Lumber.

29 pile heads, 1 ft. long.
10 pieces, 2 in. × 6 in. × 16 ft. sills.
38 pieces, 2 in. × 8 in. × 14 ft. floor joists.
130 pieces, 2 in. × 4 in. × 10 ft. studding.
38 pieces, 2 in. × 4 in. × 14 ft. ceiling joists.
28 pieces, 2 in. × 4 in. × 12 ft. plates.
24 pieces, 2 in. × 4 in. × 18 ft. cut 9 ft. for rafters.
2 pieces, 2 in. × 6 in. × 14 ft. valley rafters.
6 pieces, 2 in. × 12 in. × 16 ft. footings for posts.
2 pieces, 2 in. × 10 in. × 12 ft. cellar stair horses.
2 pieces, 2 in. × 8 in. × 12 ft. cellar stair treads.
2 pieces, 4 in. × 4 in. × 16 ft. bunk posts.
10 pieces, 2 in. × 8 in. × 16 ft. sills.
10 pieces, 2 in. × 4 in. × 16 ft. nailing for foundation skirting.
2 pieces, 2 in. × 6 in. × 12 ft. platform.
3 pieces, 2 in. × 4 in. × 12 ft. platform joists.
4 pieces, 1 in. × 6 in. × 14 ft. bunks.
2 pieces, 1 in. × 6 in. × 16 ft. bunks.
1 piece, 1 in. × 4 in. × 16 ft. bunks.
240 ft. B. M. 2 in. plank, cellar.
120 ft. lineal 1 in. × 3 in. crossbridging.
650 ft. B. M. 1 in. × 6 in. roof boards.
800 ft. B. M. T. & G. second clear flooring, surfaced.
1,100 ft. B. M. ⅞ in. × 5½ in. drop siding, second clear. (See detail.)
350 ft. B. M. ⅞ T. & G. double beaded second clear, wainscot.
50 ft. B. M. 1¼ T. & G. flooring, second clear, outside steps, etc.
280 ft. B. M. ⅞ T. & G. beaded second clear, skirting.
120 ft. lineal ⅞ in. × 8 in. base, second clear.
136 ft. lineal ⅞ in. × 5 in. facia, second clear.
136 ft. lineal ⅞ in. × 12 in. planking, second clear.
130 ft. lineal ⅞ in. × 8 in. frieze, second clear.
48 ft. lineal ⅞ in. × 5½ in. beveled base, second clear
200 ft. B. M. ⅞ in. finishing lumber, second clear, shelving, bunks, etc.
3,200 laths.
9,000 A. 16-in. shingles.
8 pieces ⅞ in. × 5½ in. × 16 ft. second clear, roof saddles.
2 pieces 1⅛ in. × 12 in. × 12 ft. second clear, outside steps.
136 ft. 1⅛ quarter round, crown mold.
72 ft. lineal ⅞ in. quarter round, exterior corners.
130 ft. lineal 1⅛ in. bead, bed mold.
100 ft. lineal wainscot cap.
148 ft. lineal ⅞ in. quarter round, wainscot base.
1 piece 1¾ in. × 14 in. × 8 ft. washing shelf.
120 ft. lineal 1⅜ in. × 1¾ in. water drip.
2 cellar windows, 1⅜ in. sash, 2 lights, 10 in. × 16 in. complete, with frames, to plan.
6 windows complete, with frames and casings, sash 1⅜ in., 8 lights, 12 in. × 16 in.; lower sash balanced, upper sash to have springs tops.
1 window as above, 12 lights, 12 in. × 16 in.
1 window and frame complete, 1⅜ in. sash, 4 lights, 12 in. × 16 in.; frame, 1¾ in. × 4⅞ in., rabbeted; sash hung at top, casings as above.
5 doors, 2 ft. 8 in. × 6 ft. 8 in. × 1⅜ in. 4 panels raised, O. G. second quality.
1 frame, with casings complete for outside door, 2 ft. 8 in. × 6 ft. 8 in. × 1⅜ in.; transom 2 lights, 10 in. × 14 in.; all to plan.
2 frames for outside doors, as above, without transoms.
2 frames for inside doors, 2 ft. 8 in. × 6 ft. 8 in. × 1⅜ in., jambs 1⅜ in. × 5¾ in., casings ⅞ in. × 4½ in. beveled.

Hardware.

120 lbs. common building paper.
75 lbs. 3 d. fine nails, lathing.
40 lbs. 3 d. shingle nails.
100 lbs. 20 d. shingle nails.
60 lbs. 10 d. shingle nails.
80 lbs. 8 d. shingle nails.
25 lbs. 10 d. finishing nails.
15 lbs. 8 d. finishing nails.
6 lbs. 6 d. finishing nails.
5 lbs. 4 d. finishing nails.
1 gross 1½ in. wood-screws No. 10.
1 gross 2-in. wood screws No. 12.
5 pairs 3½ in. × 3½ in. cast butts, with screws.
2 pairs 3 in. × 3 in. wrought butts with screws, transom, and window.
2 spring catches.
5 thumb latches.
2 left-hand rural night latches.
1 4-in. Berlin bronze slide bolt.
14 window spring stops No. 734.
28 window spring stops sockets.
14 2-in. axle pulleys.
80 ft. ¼ in. Silver Lake sash cord No. 8.
7 sash locks.
2 doz. wardrobe hooks.
12 sash weights, 6 lbs. each.
2 sash weights, 9 lbs. each.
1 sheet-iron soot drawer, 8 in. × 8 in. × 16 in.
1 terra-cotta pipe thimble, 6 in. diam. × 5 in. long.
2 terra-cotta pipe thimbles, 6 in. diam. × 10 in. long.
30 ft. 16 in. continuous I. C. valley tin.
10 ft. 14 in. continuous I. C. flashing tin.
30 galls. mineral paint.
8 galls. boiled linseed-oil.
½ gall. shellac varnish.
1 gall. turpentine.
45 lbs. mixed paint, light drab color.

Brick and Cement.

500 bricks.
8 bbls. native lime.
6 bush. hair.

Plates 15, 16, 17, and 18 show plans, elevations, and details of a standard section-house of a larger class also adopted by the Atchison, Topeka & Santa Fé Railroad Company. This is a two-story house, containing more rooms, and giving accommodations for a family, or for a larger gang of section men. It is larger, more convenient, and better in many respects than the one-story house, and is but very little more expensive to build.

Below are given the bills of material for this type of house :

No. 29. Bill of Material for Two-Story Section-House.

Plates Nos. 15, 16, 17, and 18.

Lumber.

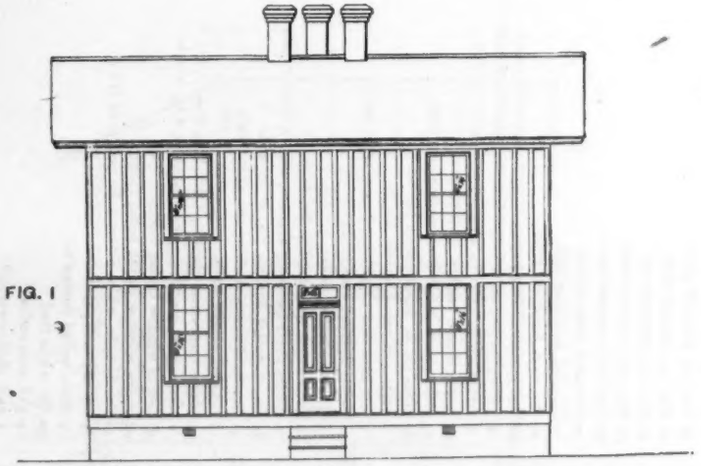
300 lin. ft. 2 in. × 8 in., sills and foundation plates.
54 pieces 2 in. × 8 in. × 16 ft. floor joists, first and second floor.
4 pieces 2 in. × 8 in. × 14 ft. floor joists, second floor.
13 pieces 2 in. × 8 in. × 12 ft. floor joists, second floor.
190 pieces 2 in. × 4 in. × 18 ft. studding, girts, plates, and sides.
32 pieces 2 in. × 6 in. × 16 ft. ceiling joists.
22 pieces 2 in. × 4 in. × 22 ft. rafters.
2 pieces 2 in. × 6 in. × 14 ft. valley rafters.
950 ft. B. M. ⅞ in. roof sheathing.
400 lin. ft. 1 in. × 3 in. crossbridging.
46 lin. ft. 2 in. × 6 in. ridge piece.
105 lin. ft. ⅞ in. × 6 in. ridge boards.
4 pieces 2 in. × 12 in. × 14 ft. stairs and cellar step strings.
2 pieces 1⅞ in. × 8 in. × 12 ft. cellar steps.
2 pieces 2 in. × 12 in. × 12 ft. step strings.
2 pieces 1⅜ in. × 12 in. × 14 ft. outside step treads.
2 pieces ⅞ in. × 8 in. × 14 ft. outside step risers.
4 pieces 1⅜ in. × 10 in. × 12 ft. inside step treads.
4 pieces ⅞ in. × 10 in. × 12 ft. inside step risers.
4 pieces 1 in. × 6 in. × 14 ft. ribbon.
2 pieces 1 in. × 6 in. × 10 ft. ribbon.
8,250 *A shingles.
1,650 ft. B. M. ⅞ in. s.l.s. common interior sheathing.
7,100 laths.
53 pieces ⅞ in. × 12 in. × 16 ft. C. stock siding exterior, lower story.
60 pieces ⅞ in. × 12 in. × 18 ft. C. stock siding exterior, upper story.
53 pieces ⅞ in. × 3 in. × 16 ft. Ogee battens.
60 pieces ⅞ in. × 3 in. × 18 ft. Ogee battens.
110 lin. ft. ⅞ in. × 8 in. C. stock water-table.
120 lin. ft. 1¾ in. × 1¾ in. water drip.
150 lin. ft. ⅞ in. × 4½ in. facia.
120 lin. ft. ⅞ in. × 12 in. frieze.
70 lin. ft. No. 836 P. F. & Co. catg. crown mold.

A. T. & S. F. R. R.

SECTION HOUSE.

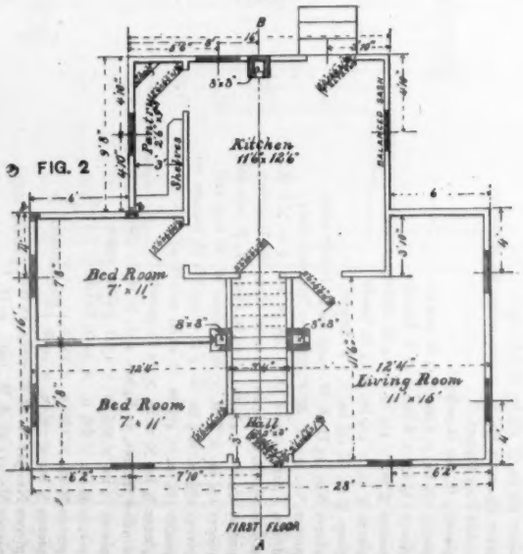
PLATE No 15.

FIG. 1



FRONT

FIG. 2



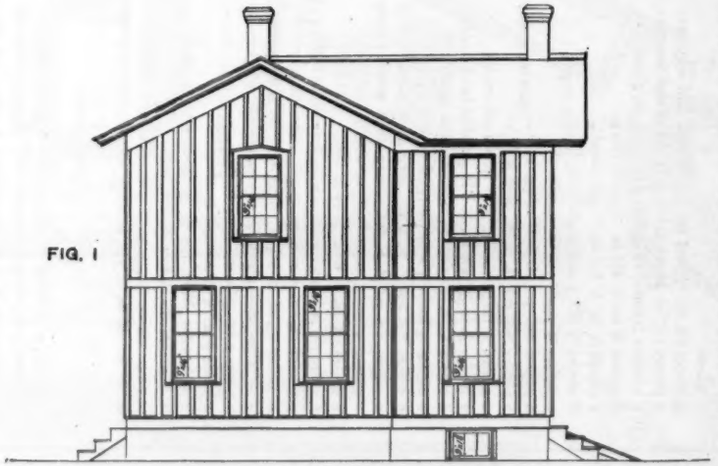
FIRST FLOOR

A. T. & S. F. R. R.

SECTION HOUSE.

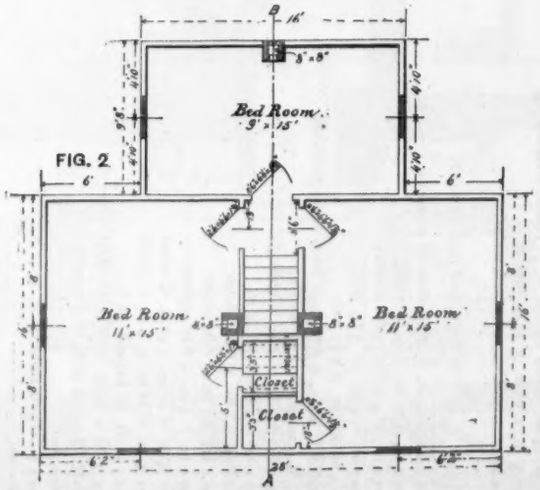
PLATE No 16.

FIG. 1



SIDE

FIG. 2



SECOND FLOOR

80 lin. ft. rake mold for ¼ pitch, to correspond to No. 836 P. F. & Co. catg.
120 lin. ft. No. 907 P. F. & Co. catg. bed mold.
1,290 ft. B. M. ⅞ in. flooring.
360 ft. B. M. ⅞ in. selected fence flooring, plancher and cellar door.
14 pieces corner beads 1⅜ in. × 3 in. for plaster corners.
20 pieces ⅞ in. × 5½ in. × 16 ft. beveled base.
320 lin. ft. No. 833 P. F. & Co. catg. base mold.
100 lin. ft. 3 in. O. G. battens, wainscot cap.
220 ft. B. M. ⅞ in. narrow beaded W. P. ceiling wainscoting.
3 pieces ⅞ in. × 10 in. × 10 ft. shelves.
6 pieces ⅞ in. × 4 in. × 10 ft. hook strips.

Water Closet and Fencing.

7 pieces 2 in. × 12 in. × 16 ft. sides of cesspool.
7 pieces 2 in. × 12 in. × 10 ft. ends.
4 pieces 2 in. × 4 in. × 7 ft. corners.
2 pieces 2 in. × 4 in. × 8 ft. sills.
1 piece 2 in. × 4 in. × 6 ft. sills.
1 piece 2 in. × 10 in. × 6 ft. floor joists under partition.
48 ft. B. M. 2 in. plank 8 ft. flooring.
15 pieces 2 in. × 4 in. × 8 ft. studding.
2 pieces 2 in. × 4 in × 16 ft. girts.
2 pieces 2 in. × 4 in. × 8 ft. plates.
2 pieces 2 in. × 4 in. × 6 ft. plates.
6 pieces 2 in. × 4 in. × 8 ft. rafters.
12 pieces ⅞ in. × 12 in. × 10 ft. C. stock.
16 pieces ⅞ in. × 12 in. × 9 ft. C. stock.
24 pieces 3 in. O. G. battens, 18 ft.
12 pieces ⅞ in. × 12 in. × 18 ft. D. stock lining.
80 ft. B. M. D. stock 10 ft. roof boards.
600 *A shingles.
2 pieces 3 in. crown mold, 18 ft.
2 ventilators.

Fencing.

49 pieces cedar posts, 5 in. diameter at small end.
130 pieces 1 in. × 6 in. × 16 ft. rough fencing boards.

Walk to Privy.

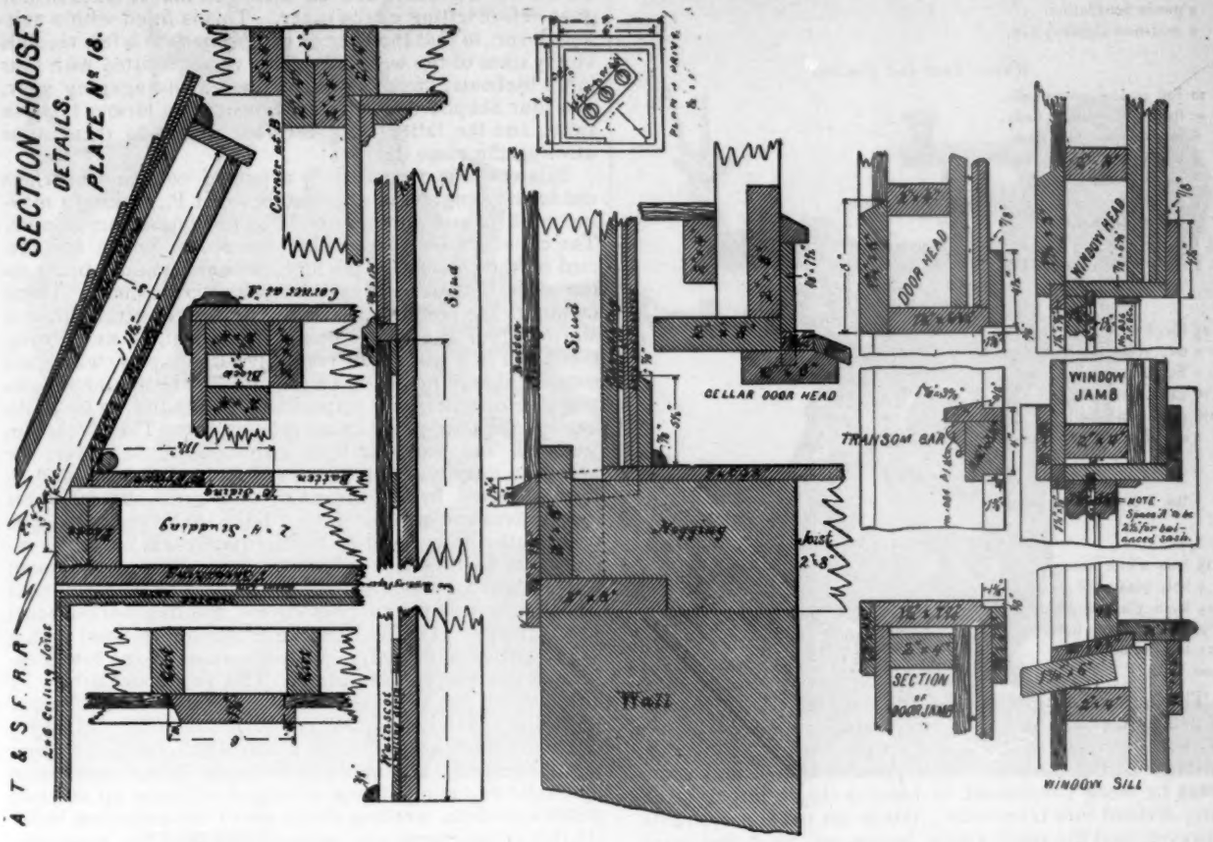
180 ft. B. M. ⅞ in. × 18 ft. fencing.
120 ft. lin. 2 in. × 4 in.

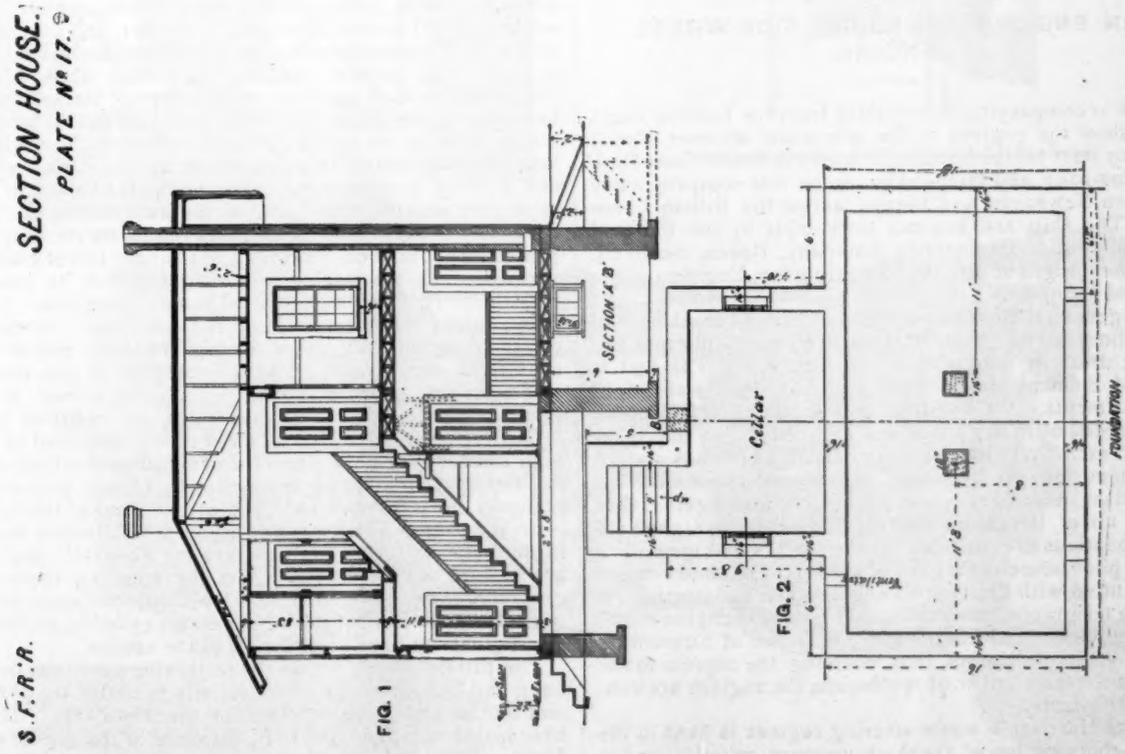
Finished Lumber.

2 outside door frames with transoms.
4 pieces 1¾ in. × 7½ in. × 9 ft. clear W. P. jambs.
1 piece 1¾ in. × 6½ in. × 7 ft. clear W. P. heads.
1 piece 2 in. × 10 in. × 8 ft. clear W. P. sills.
8 pieces ⅞ in. × 4½ in. × 9 ft. clear W. P. inside and outside casing.
1 piece ⅞ in. × 4½ in. × 8 ft. clear W. P. inside head casing.
1 piece 2½ in. × 3½ in. × 8 ft.
1 piece 1¾ in. × 3¾ in. × 8 ft. } transom bar.
8 lin. ft. molding.
2 transoms for above, 1⅝ ft., 2 lights, 9 in. × 13 in.
1 piece 1¾ in. × 5½ in. × 6 ft. rails.
1 piece 1⅜ in. × 6½ in. × 3 ft. stiles and muntins.
11 inside door frames.
11 pieces 3 ft. ash thresholds.
11 pieces 1⅝ in. × 6 in. × 14 ft. jambs.
3 pieces 1¾ in. × 6 in. × 12 ft. heads.
22 pieces ⅞ in. × 4½ in. × 14 ft. casing.
5 pieces ⅞ in. × 4½ in. × 14 ft. heads.
1 piece ⅞ in. × 4⅜ in. × 7 ft. heads.
11 pieces No. 115 H. & W. catg. 14 ft. inside stop.
3 pieces No. 115 H. & W. catg. 12 ft. inside stop.
13 doors, 4 panel raised O. G. 1⅜ × 2 ft. 6 in. × 6 ft. 6 in.
13 pieces 1⅜ in. × 4½ in. × 14 ft. clear W. P. stiles.
4 pieces 1⅜ in. × 4½ in. × 12 ft. clear W. P. top rail.
4 pieces 1⅜ in. × 8 in. × 12 ft. clear W. P. lock rail.
4 pieces 1⅜ in. × 9 in. × 12 ft. clear W. P. bottom rail.
7 pieces 1⅜ in. × 4½ in. × 12 ft. muntins.
7 pieces ⅞ in. × 12 in. × 12 ft. panels.
9 window frames, 12 lights, 9 in. × 16 in. glass.
9 pieces ⅞ in. × 6½ in. × 13 ft. pulley stiles.
3 pieces ⅞ in. × 6½ in. × 10 ft. heads.
9 pieces ⅞ in. × 1⅜ in. × 12 ft. } blind stops.
3 pieces ⅞ in. × 1⅜ in. × 10 ft. }
9 pieces No. 511 H. & W. catg. 12 ft. } parting strips.
3 pieces No. 511 H. & W. catg. 10 ft. }
9 pieces ⅞ in. × 4½ in. × 13 ft. outside casing.
9 pieces ⅞ in. × 4½ in. × 13 ft. inside casing.
3 pieces ⅞ in. × 4½ in. × 12 ft. inside head casing.
3 pieces ⅞ in. × 5 in. × 12 ft. window stool.
3 pieces ⅞ in. × 4½ in. × 12 ft. apron.
12 pieces No. 936 P. F. & Co. catg. 12 ft. window stop.
3 pieces ⅞ in. × 5½ in. × 9 ft. subsill.
3 pieces 1¾ in. × 6 in. × 12 ft. sill.
9 pairs 1¾ in. check-rail sash for above frames, 12 lights, 9 in. × 16 in. glass.
3 pieces 1⅜ in. × 10½ in. × 9 ft. rails and muntins.
9 pieces 1⅜ in. × 7½ in. × 13 ft. stiles and muntins.
6 window frames, 12 lights, 9 in. × 14 in. glass.
6 pieces ⅞ in. × 6½ in. × 11 ft. jambs.
2 pieces ⅞ in. × 6½ in. × 9 ft. heads.
6 pieces ⅞ in. × 1½ in. × 11 ft. } blind stops.
2 pieces ⅞ in. × 1½ in. × 9 ft. }
6 pieces No. 511 H. & W. catg. 11 ft. } parting strip.
2 pieces No. 511 H. & W. catg. 9 ft. }
6 pieces ⅞ in. × 4½ in. × 11 ft. outside casing.
2 pieces ⅞ in. × 4½ in. × 9 ft. outside head casing.
2 pieces ⅞ in. × 5 in. × 12 ft. window stool.
2 pieces ⅞ in. × 4½ in. × 12 ft. apron.
6 pieces No. 936 P. F. & Co. catg. 12 ft. window stop.
2 pieces No. 936 P. F. & Co. catg. 10 ft. window stop.
2 pieces ⅞ in. × 5½ in. × 9 ft. subsill.
2 pieces 1¾ in. × 6 in. × 12 ft. sill.
6 pairs 1⅜ in. check-rail sash for frames, 12 lights, 9 in. × 14 in. glass.
2 pieces 1⅜ in. × 10½ in. × 9 ft. rails and muntins.
6 pieces 1⅜ in. × 7½ in. × 12 ft. stiles and muntins.
2 cellar window plank frames (rabbeted), 3 lights, 9 in. × 18 in.
1 piece 2 in. × 12 in. × 14 ft. } frames.
1 piece 2 in. × 12 in. × 8 ft. }
2 sashes for above, 1⅜ in., 3 lights, 9 in. × 18 in.
1 piece 1¾ in. × 6 in. × 6 ft. rails.
1 piece 1⅜ in. × 7½ in. × 4 ft. stiles and muntins.
110 lin. ft. 1¾ in. × 7½ in., one side beveled and one side rabbeted band.

Hardware.

6 lights, 9 in. × 18 in. single thick A glass, cellar.
4 lights, 9 in. × 13 in. single thick A glass, transoms.
108 lights, 9 in. × 16 in. single thick A glass, first story windows.
72 lights, 9 in. × 14 in. single thick A glass, second story windows.
8 pieces 2-in. axle pulleys, kitchen windows.
2 gross ⅞-in. round-headed wood screws No. 7.
10 lbs. 8 d. common nails.
30 lbs. 10 d. common nails.
8 lbs. 8 d. finishing nails.
10 lbs. 10 d. finishing nails.
1¼ galls. boiled oil.
25 lbs. white lead.
½ gross No. 1 sand-paper.
½ gross No. 2 sand-paper.
48 lbs. putty.
14 gross glazier points.
½ keg 3 d. fine lath nails.
40 lbs. 3 d. shingle nails.
40 lbs. 8 d. common nails.
70 lbs. 10 d. common nails.
100 lbs. 20 d. common nails.
50 lbs. 30 d. common nails.
17 lbs. 8 d. finishing nails.
30 lbs. 10 d. finishing nails.
200 lbs. plain building paper.
4 pairs 3 in. × 3 in. wrought butts, transom and cellar window.
4 pieces spring catches, transom and cellar window.
13 pieces thumb latches, with screws.
13 pairs 3½ in. × 3½ in. loose pin cast butts.
1¼ gross 1½ in. wood screws No. 10.
2 gross 1 in. wood screws No. 10
1 left hand and 1 right hand rural night latch.
2 Berlin bronzed sash locks.
4 doz. wardrobe hooks.
8 pieces sash weights, 6¼ lbs. each.
3 pieces sheet-iron soot drawers, 6 in. × 8 in. × 12¾ in.
24 lin. ft. valley flashing tin, 18 in. wide.
32 lin. ft. chimney flashing tin, 14 in. wide.
5 lbs. 8 d. clinch nails.
5 pieces terra-cotta stovepipe thimbles, 6 in. × 4½ in.
2 pieces terra-cotta stovepipe thimbles, 6 in. × 9 in.
52 pieces window spring bolts.
104 pieces window spring bolts, sockets.
48 lin. ft. ¼ in. white Silver Lake sash cord No. 8.
¾ bbl. mineral paint.
9 galls. boiled linseed oil.
50 lbs. white lead.
1 gall. turpentine.
1 gall. shellac varnish.
1 lb. drop black.
1 brass padlock.
1 6-in. hinged hasp and staple.
2 pairs 8-in. T hinges, with screws.


SECTION HOUSE.
DETAILS.
PLATE Nº 16.
A T & S F R R
Stud
Nogging
Wall
DOOR HEAD
WINDOW HEAD
WINDOW JAMB
GELLAR DOOR HEAD
TRANSOM BAR
SECTION of DOOR JAMB
WINDOW SILL


SECTION HOUSE.
PLATE Nº 17.
A. T. & S. F. R. R.
SECTION A B
Cellar
FOUNDATION
FIG. 1
FIG. 2

6 lbs. putty.
3 pieces ventilators.
1 cast-iron chimney cap.

Water-Closet and Fencing.

10 lbs. 20 d. common nails.
10 lbs. 10 d. common nails.
6 lbs. 8 d. common nails.
4 lbs. 3 d. shingle nails.
3 lbs. 8 d. clinch nails.
2 pairs 3 in. × 3 in. wrought butt, with screws.
2 thumb latches.
1 night lock.
8 ft. ¼ in. × 1 in. bar-iron for ventilators.

Fence.

25 lbs. 8 d. fencing nails.
2 6-in. strap hinges and screws.
1 St. Louis gate latch.
10 galls. mineral paint.
2½ galls. boiled oil.
1 set Western gate hinges.

Privy Walk.

5 lbs. 8 d. common nails.

Lime, Cement, etc.

15 bbls. white lime.
2 bbls. plaster of Paris.
15 bush. plastering hairs.
2 bbls. common lime.
21 bbls. cement.
2,300 brick.

These plans are, of course, susceptible of such changes as are required to suit local circumstances; they are given as excellent types of small and convenient houses, entirely suitable for the purpose. It is possible that it may sometimes be more convenient to build a single larger structure, divided into tenements; this is not usually desirable, however, and the small single houses will be found better from almost every point of view. The only excuse for the large building will be the high cost of land, as in the neighborhood of a large city, or the impossibility of obtaining rooms.

(TO BE CONTINUED.)

AN ENGLISH COMPOUND SIDE-WHEEL ENGINE.

THE accompanying illustrations from the London *Engineer* show the engines of the side-wheel steamer *Paris*, recently built for the London, Brighton & South Coast Railway Company, and intended to run on that company's line between Newhaven and Dieppe, across the British Channel. The ship and engines were built by the Fairfield Shipbuilding & Engineering Company, Govan, Scotland, from the designs of Mr. William Stroudley, Engineer of the railroad company.

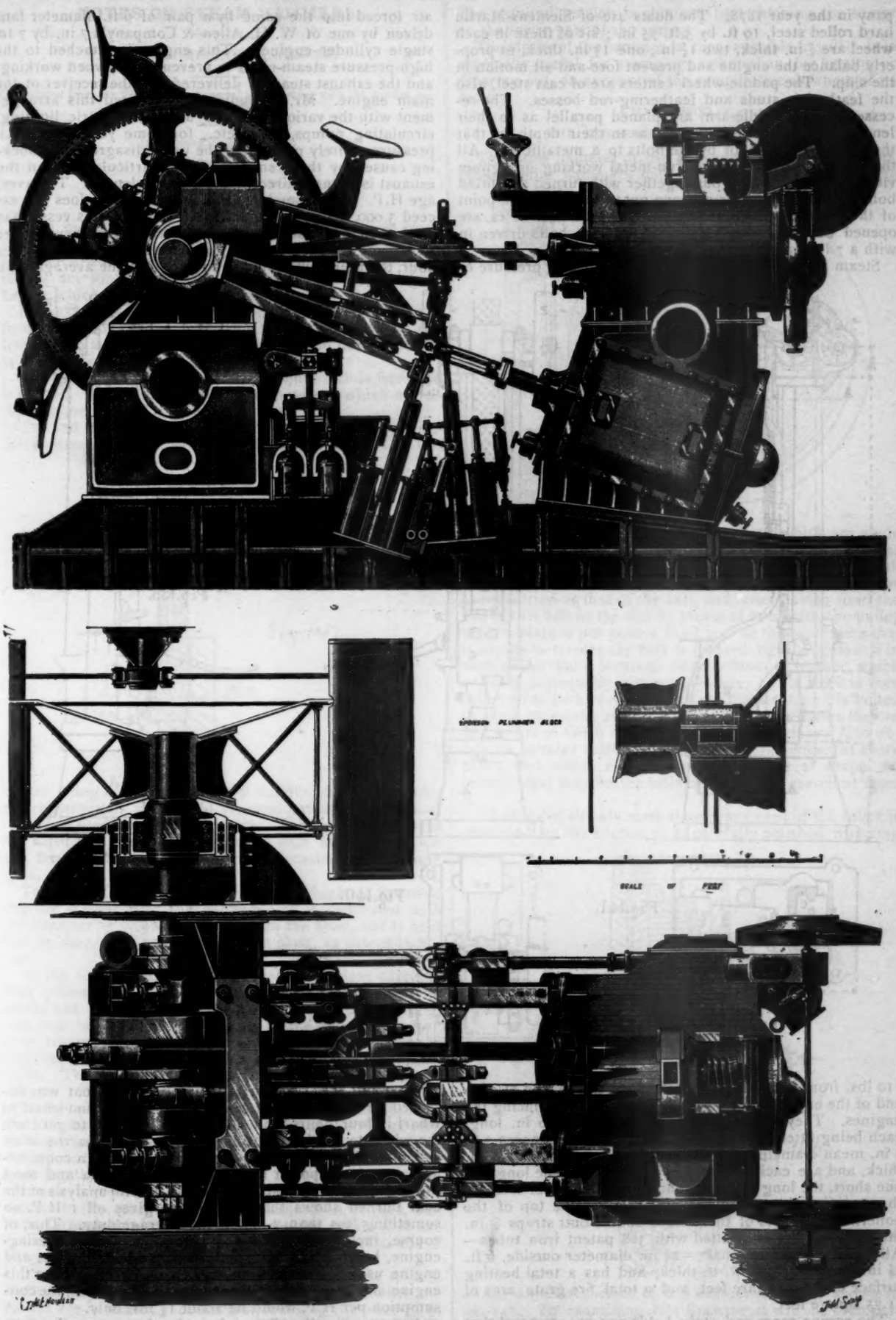
The general dimensions of the vessel are: Length on load water line, 250 ft.; breadth molded, 29 ft.; depth molded, 15 ft.; draft in sea-going order, 8 ft. 2 in. The hull is built of Siemens-Martin steel, and has seven water-tight compartments. On the trial trip, in the River Clyde, a mean speed of 19.057 knots was attained. The ship is intended exclusively for passenger business; it has accommodations for 466 first-class, 108 second-class, and 132 third-class passengers, a total of 706 passengers. The fitting up of the cabins is very handsome, and good accommodations are provided for the officers and crew.

The pilot-house is forward of the foremost smoke-stack, and is fitted with Chadburn's engine-room and steering repeating telegraphs, compass, speaking-tube to engine-room, steering-wheel, and chart table; also one of Stroudley's patent speed indicators, thus enabling the captain to see at a glance the number of revolutions the engines are running per minute.

One of Harrison's steam-steering engines is fixed in the engine-room on top of the high-pressure cylinder, and is worked from the pilot-house for steering the vessel. There is also a powerful hand-steering gear fitted over the rudder, the connections being effected by a clutch which slides on the rudder-head, and so arranged that it takes in one gear before letting go the other. This is fitted with a suitable lever, so that the change can be made in a few seconds in any state of the weather. This vessel is fitted with four large lifeboats, having Sample Ward's disengaging gear, and four Shepherd's collapsable boats, the former lying in skids, and the latter lying inverted alongside them, thus utilizing the same davits.

This vessel is propelled by a pair of compound surface condensing engines of 3,400 indicated H.P., making a maximum of 52 and a minimum of 49 revolutions per minute. The cylinders are placed abaft the shafts, which are carried on the condenser, the high-pressure cylinder being on top of the low-pressure cylinder, which is diagonal. These cylinders are placed one slightly to port, and the other to starboard of the center line of the vessel, so as to bring them into line with their respective crank-pins, which are connected together with a drag link. The high and low-pressure cylinders are respectively 46 in. and 83 in. in diameter, the stroke in both cases being 6 ft. They are steam jacketed, and provided with manholes in the covers for access to interior. The pistons are of cast steel, of dish form, adopted by Mr. Stroudley with great success in his locomotives and steam vessels. Each junk-ring has a shoe cast on the lower part of its circumference, so as to increase its bearing area on the cylinder. This arrangement was designed by Mr. Stroudley, to dispense with tail-rods passing through the cylinder covers, and has worked most satisfactorily. The high-pressure cylinder is fitted with a single-ported slide valve, while the valve of the low-pressure cylinder is double-ported. The valves are driven by link motion, the expansion links being of the double-bar type. The valve spindles, eccentric rod ends, and lifting links, are fitted with adjustable bearings. Each valve motion is reversed separately by Brown's patent steam and hydraulic reversing engine arranged with one oil and two steam cylinders, working direct on to the expansion links. By this arrangement the engineer can alter the expansion of each engine as required. The crank-shafts, crank-cheeks and pins, the latter forged in one piece, are of Siemens-Martin steel, Messrs. Vickers, Sons & Company's best make; the whole of the other forgings for the engines and paddle-wheels are of Siemens-Martin steel—Parkhead Forge Company's make—of a tensile strength of 33 tons per square inch, and capable of being folded up quite close while cold. The shafts are 16 in. diameter, and the crank-cheeks and pins are forged solid. The crossheads have adjustable guide faces of cast steel lined with white metal; the condenser is of cast iron, with plummer blocks cast on for carrying the air-pump shaft, and cast-steel plummer blocks attached for carrying the main shafts. These have long brackets bolted to the coaming of the engine-room, and forming a very strong cross-stay to the vessel, at the same time securing the rigidity of the main bearings. The condenser is fitted with brass tubes tinned on the outside, ¾ in. external diameter, having 3,681 square feet of cooling surface. The condensing water is supplied by one of Messrs. W. H. Allen's centrifugal pumping-engines. This pump forces the water through the condenser, the tubes of which are in two groups, so that the water makes two runs from end to end. The air-pump is of gun-metal, single-acting, 37 in. diameter, with 30-in. stroke, fitted with Thompson's patent metallic valve, and is driven by a bell-crank lever connected by a rod to the crosshead of the high pressure engine. From the same pump shaft are also driven two feed and two bilge-pumps, having gun-metal plungers 8 in. diameter and 18-in. stroke; one of the latter is arranged to work as a sanitary pump, to circulate water through the water-closets and urinals when the engines are at work. The various levers for handling these engines are brought together on a level with the main deck, immediately in front of the high-pressure cylinder, enabling the engineer to have a good view of the engine.

The paddle-wheels are on the feathering principle, overhung and supported by cast-steel slings under the plummer blocks and wing brackets on the ship's side. They have inside rims, and are 17 ft. diameter to the axes of the floats. There are nine floats in each wheel curved on the driving face, with flanges at the ends as designed by Mr. Stroudley for the steamships *Brighton* and *Victoria*, built by Messrs. John Elder & Company, for the Brighton Com-



ENGLISH COMPOUND SIDE-WHEEL ENGINE.

pany in the year 1878. The floats are of Siemens-Martin hard rolled steel, 10 ft. by 3 ft. 7½ in.; six of these in each wheel are ⅞ in. thick, two 1¼ in., one 1⅝ in. thick, to properly balance the engine and prevent fore-and-aft motion in the ship. The paddle-wheel centers are of cast steel, also the feathering studs and feathering-rod bosses. The recesses for the paddle-arm are planed parallel as to their length, but are slightly tapered as to their depth, so that the arms are drawn in by the bolts to a metallic fit. All the wearing surfaces are of gun-metal working on lignum vitæ. All this work is put together with turned and fitted bolts, having cup heads and one nut to each bolt, the point of the bolt being lightly riveted over. All bolt holes are opened out with a cylinder drill, and the bolts driven in with a 7-lb. hammer.

Steam is supplied to the engine at a working pressure of 110 lbs. from four multitubular boilers, two placed at each end of the engine-room, with the furnace fronts facing the engines. They are 13 ft. diameter and 9 ft. 6 in. long, each being fitted with three Fox's corrugated furnaces 3 ft. 5 in. mean diameter by $\frac{7}{16}$ in. thick. The shells are $1\frac{1}{16}$ in. thick, and are each composed of two plates, one long and one short, the long plate extending from the water-level on the opposite side, the shorter going over the top of the boiler. The joints of these have double-butt straps ⅞ in. thick. Each boiler is fitted with 318 patent iron tubes—Allan, of Coatbridge, make—2¾ in. diameter outside, 6 ft. 7½ in. long, No. 9 B. W. G. thick, and has a total heating surface of 1,842 square feet, and a total fire-grate area of 71.75 square feet.

The engine-room and stoke-holds are so arranged that the doors, windows, etc., can be made air-tight, and the air forced into the same by a pair of 6 ft. diameter fans driven by one of W. H. Allen & Company's 7 in. by 7 in. single cylinder engines. This engine is attached to the high-pressure steam-chest to prevent noise when working, and the exhaust steam is delivered into the receiver of the main engine. Mr. Stroudley has adopted this arrangement with the various engines used for electric lighting, circulating pumps, fans, etc., for some years, the back pressure entirely preventing the usual disagreeable knocking caused by these small engines, particularly when the exhaust is turned directly into the condenser. The average H.P. used in making the ordinary runs does not exceed 3,000. The maximum speed at which this vessel has worked on the passage between Newhaven and Dieppe gives an average from pierhead to pierhead of 19¼ knots per hour, the time being 3 hours 20 minutes; the average time for a month was 3 hours 32 minutes. This boat was designed for the purpose of making the passage from wharf to wharf in four hours, and as the time required to get from the wharf to pierhead and pierhead to wharf on the other side only amounts to about 12 minutes, it has a considerable margin of power to keep the official time and meet the emergencies of bad weather. A careful analysis of the coal burned shows that this engine gives off 1 H.P. on something less than 2 lbs. of the average duty. This, of course, includes steam used in the fan-engine, steering-engine, heating all cabins, etc., steam-winch engine, and engine used for circulating condenser water. Were this engine only credited with the coal actually burned, the consumption per H.P. would be about 1¾ lbs. only.

A sister ship, the *Rouen*, has also been recently completed and put on the same line.

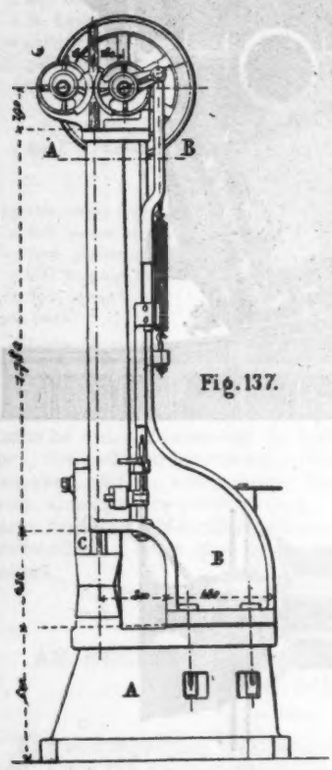


Fig. 137.

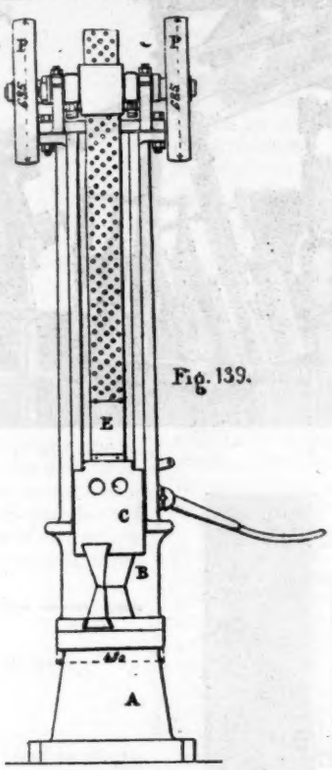


Fig. 139.

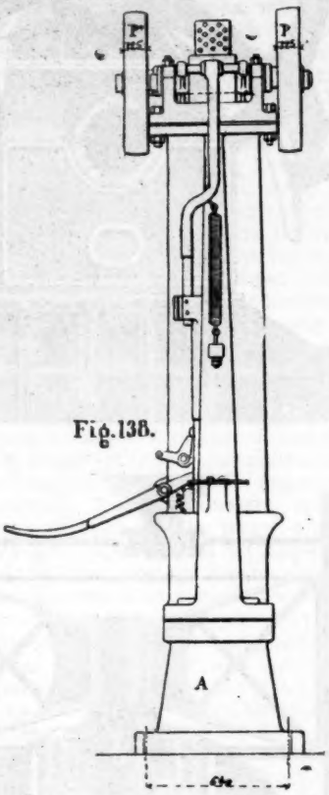


Fig. 138.

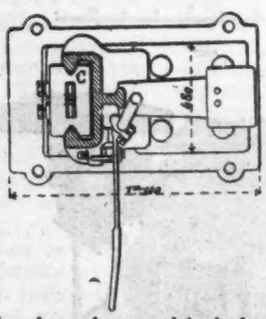


Fig. 141.

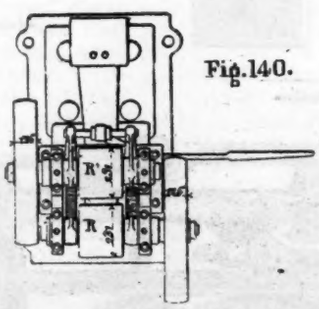


Fig. 140.

NOTES ON STEAM HAMMERS.

By C. Chomienne, Engineer.

(Translated from the French, under special arrangement with the Author, by Frederick Hobart.)

(*Continued from page 167.*)

CHAPTER XLIII.

THE HASSE DROP HAMMER.

This hammer, represented in figs. 137–42, differs from those previously described, in that the rod by which the hammer is worked is a wooden plank, upon which friction rollers act for the purpose of raising the hammer to a height which may be varied at will.

Fig. 137 is a side view; fig. 138, a rear view; fig. 139, a front view; fig. 140, a plan, and fig. 141 a section on the line *A B* in fig. 137. The hammer shown in the engraving is of 150 kilog. weight.

It is composed of an anvil-block *A*, on which is fixed the frame *B*; this frame carries slides between which moves the hammer *C*.

The rod or board *E* of the hammer is formed by three thicknesses of wood, as shown in section in fig. 142, the

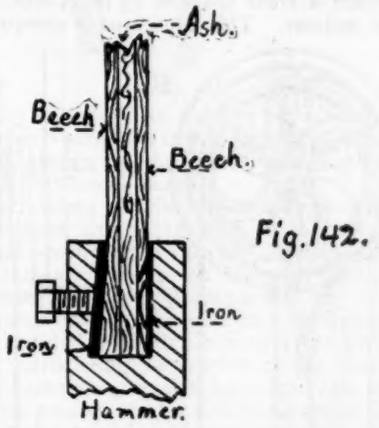


Fig. 142.

center being of ash and the two outside plates of beech; the construction of this rod requires particular care, and the wood used should be very dry. The three thicknesses are fitted together and then pierced with holes into which are forced wooden pins, previously coated with strong glue.

To prevent the rod from rising too high, it is made slightly thicker near the hammer. It is connected with the hammer by means of a mortise in the head, and is held fast by set-screws acting on an iron plate, as shown in fig. 142.

At the top of the frame there is fixed a plate carrying four pillow-blocks, intended to receive the two driving shafts and the friction rollers *R R'*. These rollers are of cast iron, and are turned exactly of the same diameter; they receive a continuous rotary movement in opposite direction, by means of two pulleys *P P'* worked by crossed belts. These pulleys are run from 100 to 120 turns per minute. The friction necessary to raise the plank by the rollers is produced by drawing the latter together through the following arrangement: The shafts of the rollers turn in cast-iron eccentric boxes, which can themselves turn in the pillow-blocks; these boxes carry toothed sectors which gear together in pairs. By means of the rod *E* the hammerman moves two of these boxes, which transmit the motion to the other two through the toothed sectors, and thus, through this eccentric movement, the rollers *R R'* are made to approach each other, or to separate. The rod *E* is worked by the hand-lever *L*.

The spring *S* serves to regulate the contact of the rollers, so that the hammer may be kept slightly raised when the rollers are in motion, and without touching the lever *L*, in such a way that the work required to raise the hammer is very slight when the tension of the spring is sufficient. The required tension is obtained by tightening the screw on the lower part of the spring.

The stroke of the hammer is, then, variable at will. It is especially useful for stamping, rather than for forging or drawing out, on account of the comparative slowness of its action.

CHAPTER XLIV.

THE SCHOENBERG DROP HAMMER.

The drop hammer of the Schoenberg type differs from other similar hammers only in the method of raising the

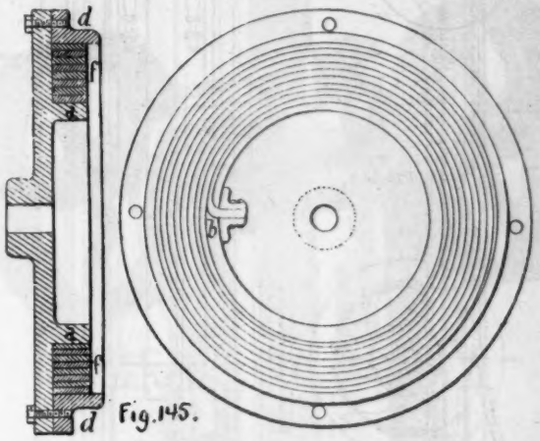


Fig. 145.

rod, and by the construction of the rollers, which are made as described below. After having cast upon the arms of a pulley or face-plate a lug *d*, fig. 145, of the same width as that of the hammer-rod or belt, a slot *b* is made of the same section as that of the belt, and, after having fixed the end of this belt in the slot by means of two bolts, the pulley or face-plate is put upon a shaft and at the same time that it begins to revolve the belt is pressed tightly against it in such a way that it forms an annular block of leather, which is left to dry equally without pressure. This block is then taken off to be turned up to a fixed diameter, and is bolted in place by means of a ring *d' d*. All that remains then to be done is to finish it up properly on the surface *f f*, to obtain an annular leather plate, which is in contact at every point, and which cannot possibly get out of shape, no matter what may be the ultimate pressure exercised upon it.

As we have already seen, the engagement of the roller is produced by the friction of a carefully polished iron ring

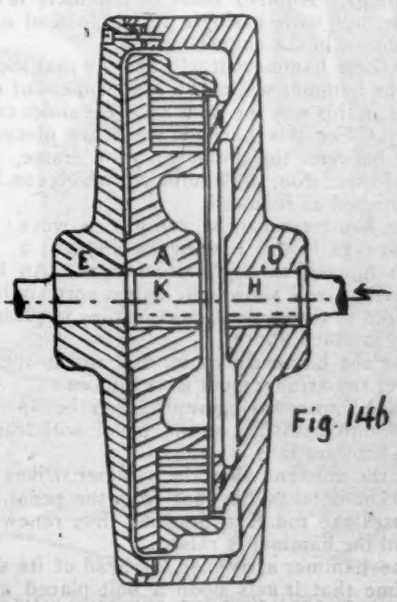


Fig. 146

on the annular surface of this leather block, as shown in fig. 146. By examining this drawing it will be seen that the plate *A* is fastened to the shaft *K*, which moves the whole mass, or is moved by it; the plate *D*, fixed upon the

shaft *H*, movable in a horizontal direction, is of cast iron, with the friction plate *I I* of which we have already spoken. In order that the surfaces may not lose their contact at any moment, a third plate, *E*, fastened to the plate *D* by a series of screws, encloses the plate *A*, and has its bearing on the

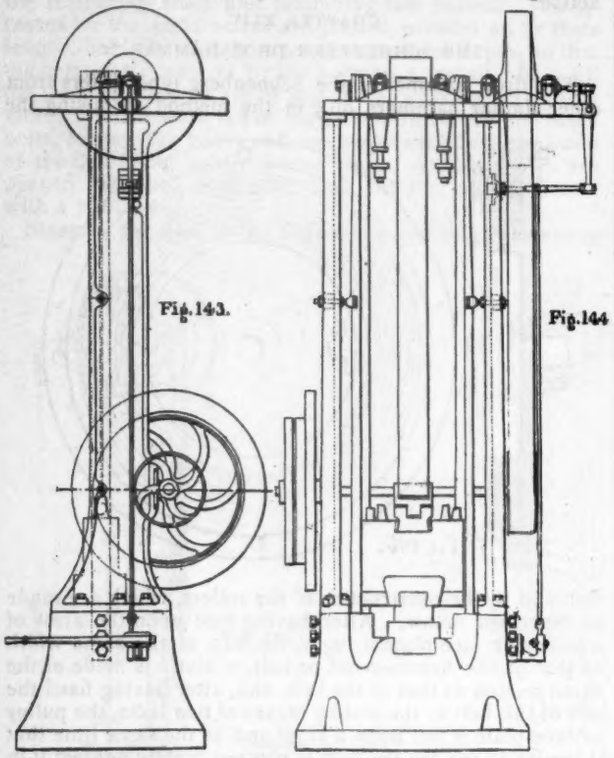


Fig. 143. Fig. 144

driving shaft *K*, but is not fastened to that shaft, turning loosely upon it.

To set the hammer in motion by hand only requires the movement of levers sufficient to produce the very slight motion needed to bring together the two friction plates, which are less than a millimeter apart.

The general construction of the hammer is shown in figs. 143 and 144, fig. 143 being a side view and fig. 144 a front view. The hammer shown here is one of 350 kilogs, made by M. Delinotte, at Paris, who holds the French patent. They are made of weights varying from 350 to 1,800 kilogs. Another class of hammers is on the same principle, but with a single frame, instead of the double frame shown in the engraving.

In all these hammers it will be seen that the slides upon which the hammer works are independent of the cast-iron frames; in this way the wear upon the slides can be readily taken up. For this purpose there are placed at top and bottom, between the slides and the frame, several thin plates of sheet iron, the number of which can be increased or diminished as required.

These hammers can be run in two ways: 1. By hand, being worked in this case by the helper; 2. By the hammerman himself through a foot-lever. An inspection of the drawings will show that only a very slight movement is required to throw the friction pulley in place or to withdraw it, as noted above.

Where the hammerman himself works this tool with a foot-lever the arrangement is as follows:

1. The hammer having approached the top of the stroke, the workman pressing on the pedal withdraws the lock, and the hammer falls.

2. At the moment when the hammer strikes the forging, the workman takes his foot from the pedal, which rises and causes the rod *E* to descend, thus renewing the friction, and the hammer is raised.

3. The hammer arrives at the head of its stroke at the same time that it acts upon a bolt placed at this point, pushes a dog acting on the rod *T*, which, then freed from friction, leaves the hammer ready to fall when the workman presses on the pedal. As will be seen, the mechanism is very simple. Moreover, the automatic action of the hammer can be varied for different heights by changing the bolts and the dog which throws the friction rollers into action. When the height of the fall is once regulated in this way, it remains the same until again changed.

This type of hammer is especially convenient for die work and for stamping small pieces, and is largely used in the State factories of small arms at St. Etienne, Tulle, and Chatellerault, and also in many private workshops.

CHAPTER XLV.

THE BARBIER DROP HAMMER.

The principal inconvenience of drop hammers is, that hitherto they have been principally worked by some system of pulleys with springs, and these springs act constantly to a greater or less degree on the bolt or rod in the descent of the hammer. From this there results a heating of the rod or plank and a complete absence of adhesion, which, with heavy hammers, makes it impossible to work them continuously. Moreover, this heating of the belt or plank and the continual friction produce rapid wear.

The Barbier drop hammer, shown in figs. 147, 148, and 149, differs from other hammers of this class by a use of an apparatus called an isolator, the object of which is to draw the belt back from the friction pulley. Before describing this we should say that in the Barbier hammer the driving pulley or friction pulley is formed by two pulleys with dished sides, carried on the same shaft, but having between them a clear space of 25 to 35 mm., in which is placed the isolator. This apparatus is composed of three

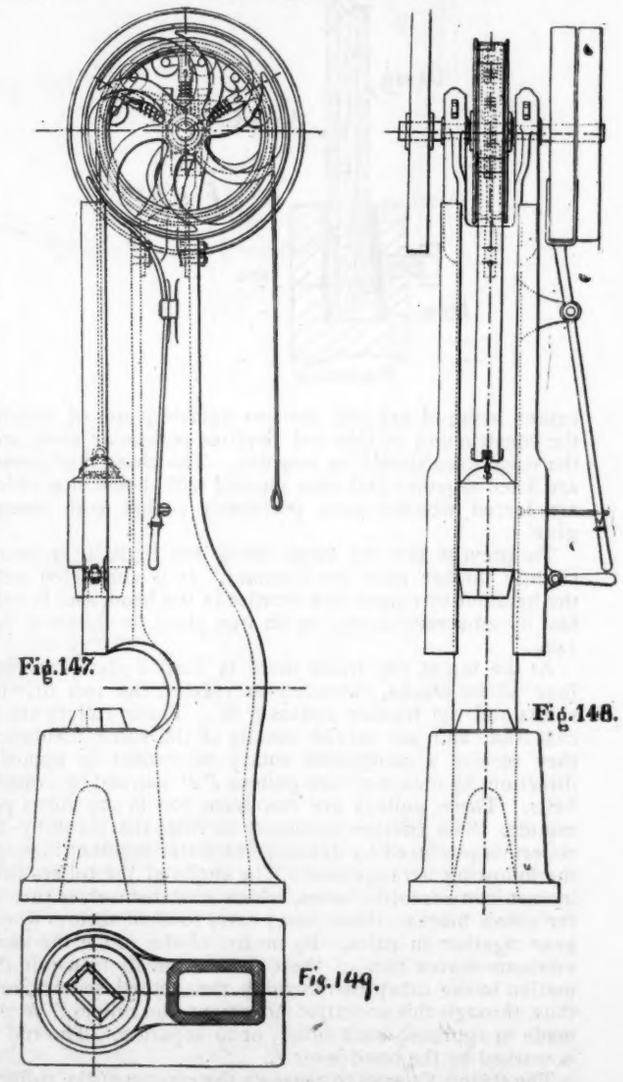


Fig. 147. Fig. 148.

Fig. 149.

groups, each of two small rollers; each of these systems moves on a rod, where it is held in place by a spring.

The isolator is regulated in such a way that when it is at rest these rollers are higher than the pulley, and raise the belt clear of it. In putting the belt at work the rollers

are lowered by the pressure exercised by the workman, the belt adheres to the pulley and raises the hammer. But as soon as the pressure is removed the springs throw up the rollers and free the belt, which then moves over these rollers, instead of pressing upon the springs, as in the other hammers. In this way the continual friction and the rapid wear of the belt or rod are avoided, and moreover the hammer strikes with its full force, because it has no resistance to overcome.

The diameter, the face and the speed of the friction pulley being determined and calculated according to the

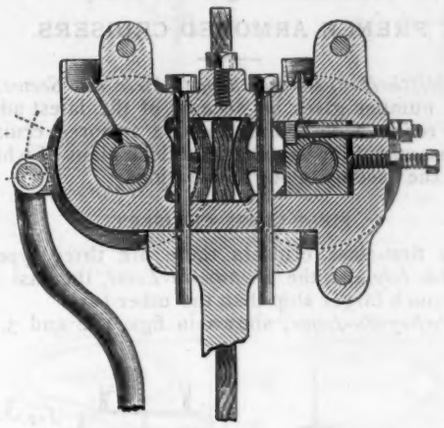


Fig. 151.

weight of the hammer, the work to be done by the hammerman consists simply in exercising sufficient force to deflect the spring carrying the rollers, and this work can be reduced to a very small quantity.

Many applications of this system have been made upon existing hammers and in stamping machinery; a notable one is in the die-hammers or stamps used in the manufacture of zinc ornaments, where the striking mass frequently weighs as much as 450 kilogrammes.

On the other hand, die-work and stamping done by hammers provided with this arrangement give excellent results, as, there being no friction at the moment of the stroke, the hammer gives its full blow and without reaction. This arrangement is found at work in many shops of greater or less importance, and also in a number of the State workshops and arsenals.

CHAPTER XLVI.

THE MERRILL DROP HAMMER.

This hammer, which is manufactured by Merrill Brothers, Brooklyn, N. Y., is shown in perspective in fig. 150. Fig. 151 is a section of the head, showing the method of working the friction rollers, which especially distinguishes this hammer from others of the same class.

The Merrill hammer has the general features of all drop hammers—that is, the anvil and upright frames carrying the slides in which the hammer works, the heavy hammer-head, and the board upon which the friction rollers act to raise the hammer. The rollers are carried on two separate shafts running in pillow-blocks carried at the top of the frame, and each shaft has its pulley driven by a separate belt; all gearing is thus dispensed with. The rear shaft—that is, the one at the back of the board—runs in boxes of the ordinary pattern, which can, however, be set up by means of set-screws, to take up wear in the board or in the rollers. The shaft on which the front roller is keyed runs in eccentric sleeves, placed in stationary boxes, and the movement of these sleeves brings the rollers in contact with the board, or, by releasing them, leaves the hammer free to drop. The motion required of these eccentric sleeves is only a small portion of a circle; they carry arms to which is attached the drop-rod. When this rod falls it revolves the sleeve and brings the rollers into contact with the board. When the rod is raised the rollers are separated, and the motion is so arranged that they are then well apart, and do not touch the board, leaving the hammer perfectly free to fall without friction, and with its full weight. The drop-rod is made heavy, so that its weight will always be sufficient to bring the rollers into place.

The rollers can be moved at the pleasure of the operator. By pressing the treadle down the latch on the right side, on which the hammer rests when not at work, is thrown out, and at the same time the drop-rod is raised, opening the rollers and allowing the hammer to fall. As soon as

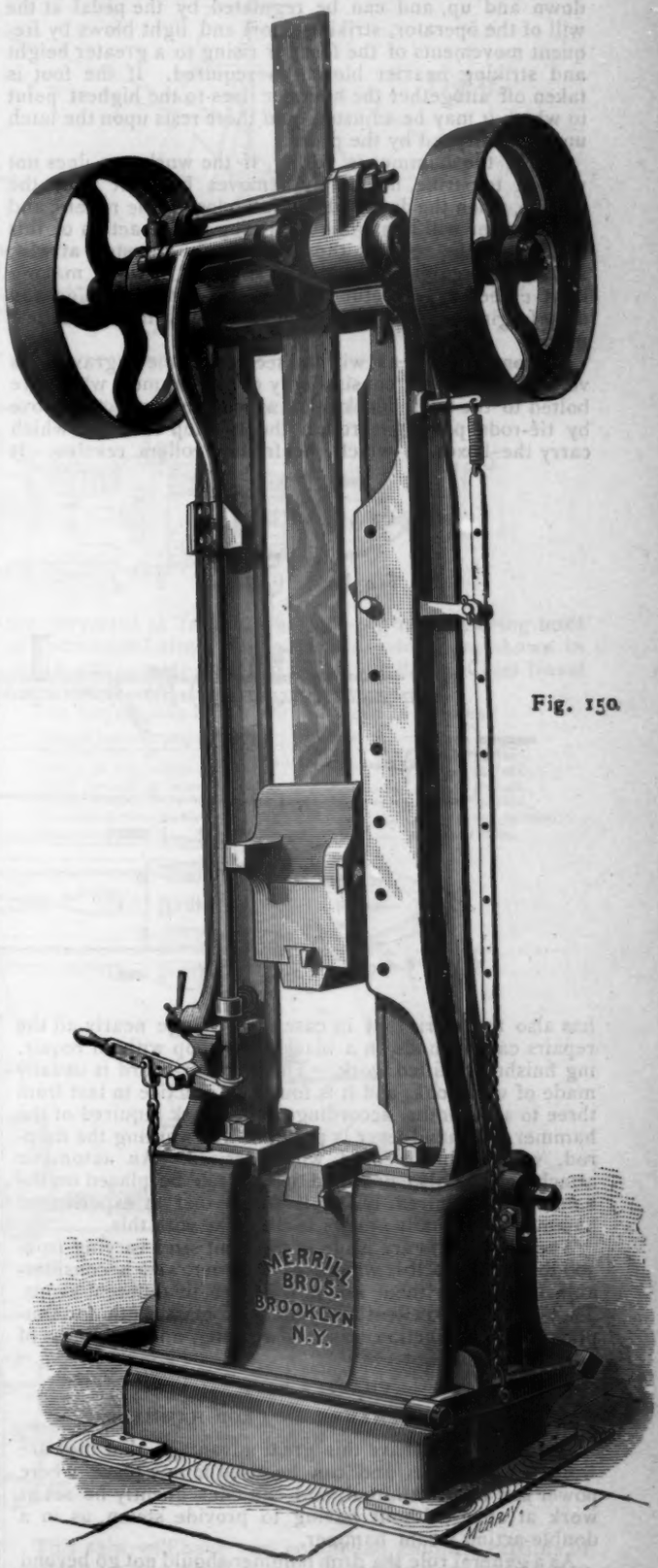


Fig. 150.

the blow is struck the foot is raised from the treadle, and the drop-rod and arms fall by their own weight, throwing the rollers together, and the hammer rises immediately. The latch, which is shown in fig. 150 on the right-hand side, serves to hold the hammer up safely and out of the

way when the dies are being adjusted, or when the hammer is not in use. It is held in place by a pin passing through the frame, and can be adjusted at a number of different heights.

The hammer will thus follow the motion of the foot down and up, and can be regulated by the pedal at the will of the operator, striking short and light blows by frequent movements of the foot, or rising to a greater height and striking heavier blows, as required. If the foot is taken off altogether the hammer rises to the highest point to which it may be adjusted, and there rests upon the latch until it is tripped by the pedal.

While the hammer is falling, if the workman does not wish it to strike, he simply removes his foot from the treadle, when the drop-rod will fall, closing the rollers, and the hammer will rise without striking. The action of this tool, it will be seen, is thus very easily adjusted at will, and can be regulated for almost any kind of work, making it an exceedingly useful tool for die-work, stamping and drop forgings of all kinds, from the largest to the smallest pieces.

Its construction, as will be seen from the engraving, is very simple, as it consists only of the frames, which are bolted to the anvil block, and which are connected above by tie-rods passing through the two top castings, which carry the boxes in which the friction rollers revolve. It has also the merit that in case of breakage nearly all the repairs can be made in a blacksmith shop without requiring finished or fitted work. The hammer-board is usually made of white oak, and it is found in practice to last from three to six months, according to the work required of the hammer. A hand-lever is provided for working the drop-rod, which can be used when desired. An automatic attachment is also provided which can be placed on the hammer if required, but it is found that an experienced hammerman usually prefers to dispense with this.

These hammers are made in different sizes varying from 300 lbs. to 1,800 lbs. weight of hammer, and a considerable number of them are now in use in different shops. They are very excellent tools of their class, both for simplicity of construction, ease of working, and readiness of adjustment.

CHAPTER XLVII.

GENERAL REMARKS ON DROP HAMMERS.

Drop hammers have this great advantage, that they are worked from belts and can be used in any place where power can be transmitted, and can consequently be set at work at once, without having to provide steam, as in a double-acting steam hammer.

As a general rule the drop hammer should not go beyond 300 kilogs. (660 lbs.) weight of hammer, and it is safer beyond that weight to use the double-acting steam hammer.

There is one exception to this rule, and that is with hammers used for stamping or drop forgings; with these we may go as high as from 600 to 1,500 kilogs. (1,300 to 3,300 lbs.) weight of hammer and a stroke as long as 3 meters (9.84 ft.).

With these limitations the drop hammer is an exceedingly useful tool, and finds an appropriate place in a large number of work-shops. It will be found available in many small shops where the work required would hardly warrant the erection of the boilers and other accessories needed for a steam hammer.

(TO BE CONTINUED.)

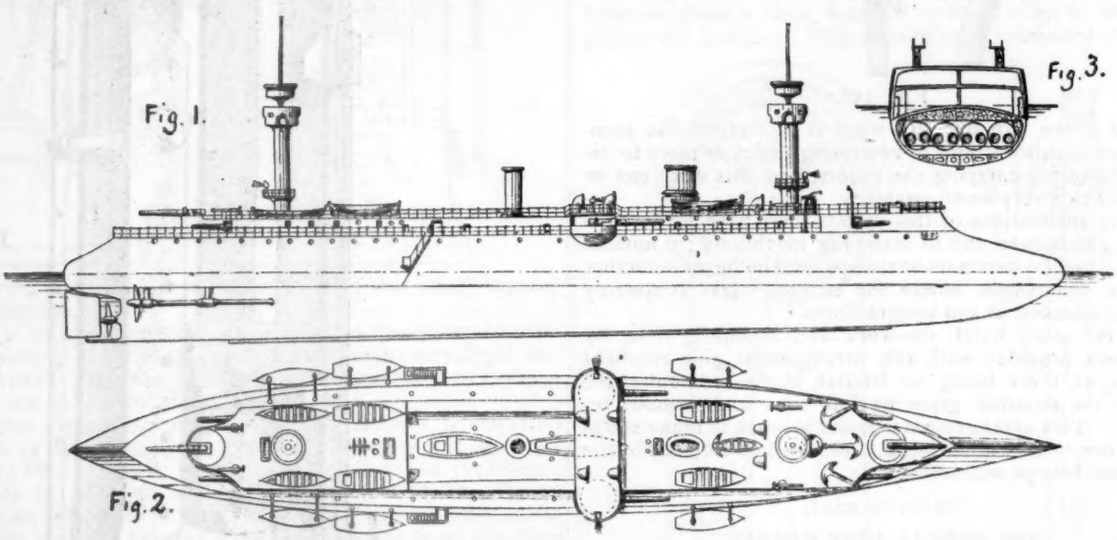
FRENCH ARMORED CRUISERS.

THE *Mittheilungen aus dem Gebiete des Seewesens* in a recent number gives an account of the latest additions to the French Navy, which include armored cruisers of three classes, outline sketches and deck plans of which are given in the accompanying illustrations.

FIRST-CLASS CRUISERS.

Of the first-class cruisers there are three types, the *Alger*, the *Isly* and the *Dupuy-du-Lome*, the last named being a much larger ship than the other two.

The *Dupuy-du-Lome*, shown in figs. 1, 2 and 3, is the only one yet built of its type. It is to be provided with armor which will resist shells loaded with melinite. The general dimensions are as follows:



Length over all	114.00 meters (374 ft.).
Extreme breadth on water line	15.70 meters (51½ ft.).
Depth of hold	6.90 meters (22½ ft.).
Draft forward	6.27 meters (20½ ft.).
Draft aft	7.87 meters (26 ft.).
Draft, mean	7.07 meters (23 ft.).
Immersed cross-section	90.55 sq. meters (974 sq. ft.).
Total displacement	6,296 tons.

The ship is provided with three screws, driven by three compound engines capable of working up to 14,000 H.P., and of driving the ship at the rate of 20 knots an hour.

The armament of this ship is as follows: Two 19-cm. (7½-in.) guns in the casemate on the upper deck, each having a range of 180°; six 16-cm. (6½-in.) guns, three forward, two being on the upper deck and one on the forecastle, all three trained forward, the other three being aft and arranged in the same way; four 65-mm. (2½-in.) rapid-fire guns, two forward and two aft; four 47-mm. (1 85-in.) rapid-fire guns carried on the military masts, and eight 37-mm. (1½-in.) revolving cannon. The position of these guns is shown in fig. 2.

The ship, which is more of a fighting vessel than a cruiser, is not rigged and has only two military masts.

The *Dupuy-du-Lome* is built from the plans of M. de Bussy, Chief Naval Constructor, and under his direction.

The *Isly* type—of which there are two, the *Isly* and *Jean Bart*—is shown in figs. 4 and 5, while the *Alger* type, of which the *Alger* is so far the sole representative,

is shown in figs. 6 and 7. These two types are cruisers properly so called, and are rigged and provided with sails. The differences in the arrangement of the armored decks, guns, etc., are well shown in figs. 5 and 7.

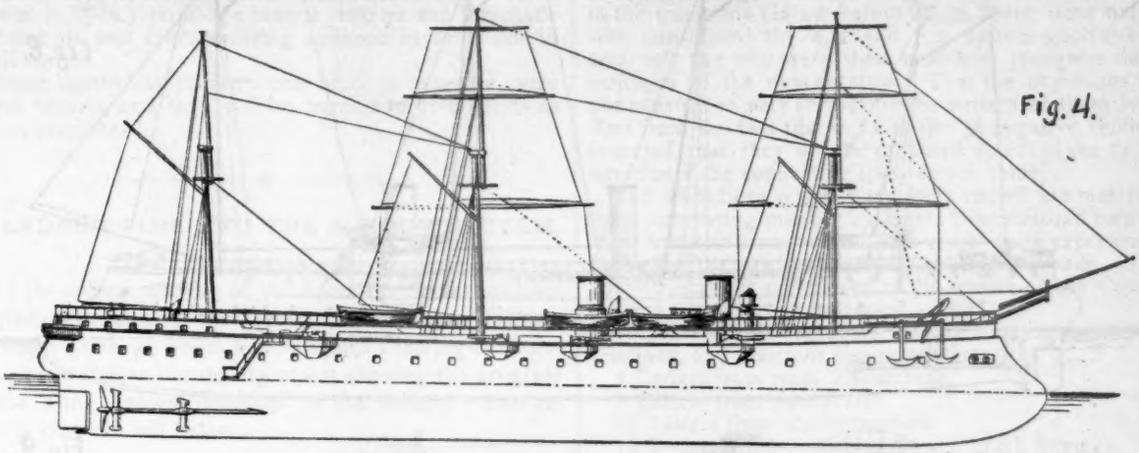


Fig. 4.

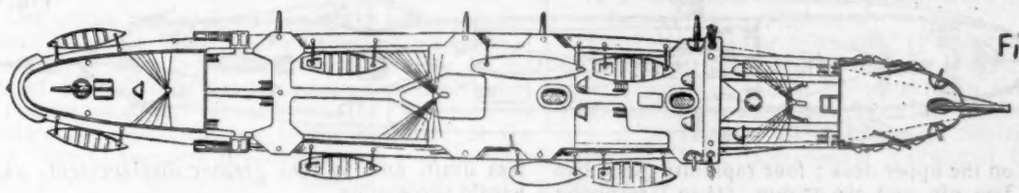


Fig. 5

The dimensions are as follows :

	Isly type.	Alger type.
Total length	105.40 meters.	105.60 meters
Extreme breadth	13.28 meters.	13.80 meters.
Depth of hold	9.30 meters.	9.30 meters.
Draft forward	5.60 meters.	.....
Draft aft	6.14 meters.	6.20 meters.
Draft, mean	5.74 meters.	5.50 meters.
Total displacement	4,123 tons.	4,123 tons.

The armament of these ships is not given.

The *Isly* and *Jean Bart*, designed by Chief Engineer Thibaudier, were built at Indret-sur-Loire, and have each two compound engines which will work up to 8,000 H.P. Their highest speed is 19 knots an hour. The *Alger* also has two engines working up to 8,000 H.P.; the ship is being built in the navy-yard at Cherbourg and the engines at Creusot. The *Alger* has boilers of the Belleville type. This vessel was designed by Chief Engineer Marechal.

SECOND-CLASS CRUISERS.

The second-class cruisers are represented by the *Davoust* and a sister ship, the *Souchet*, now under construction in the navy-yard at Toulon, while the engines are being built at Indret-sur-Loire. These vessels, which are shown in figs. 8 and 9, were designed by M. de Bussy, Chief Naval Constructor.

The dimensions of the *Davoust* are as follows :

Length between perpendiculars	88.00 meters.
Breadth over all	12.30 meters.
Depth of hold midships	5.25 meters.
Draft (including false keel) aft	6.15 meters.
Draft, mean	5.35 meters.
Immersed cross-section	55.54 sq. meters.
Displacement	3,027 tons.

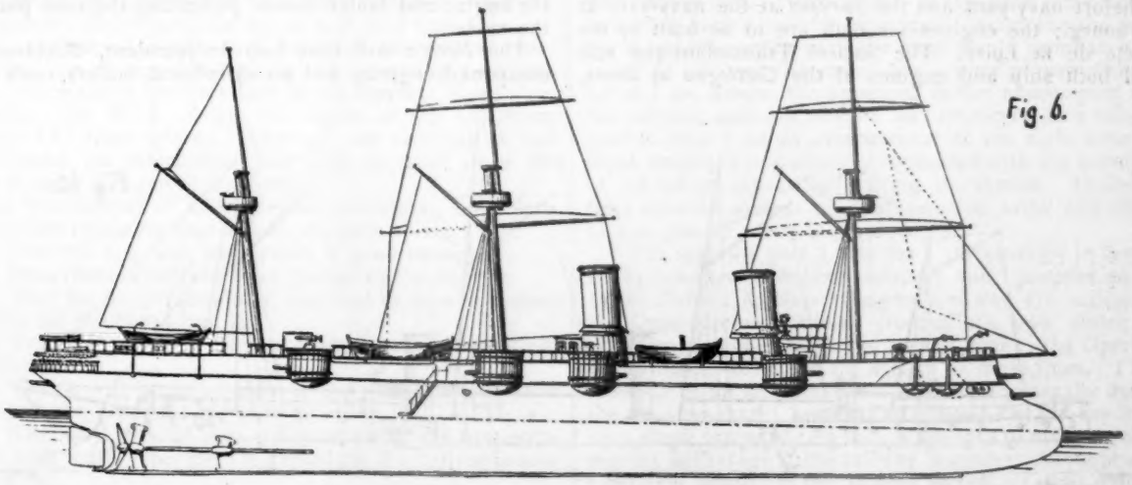


Fig. 6.

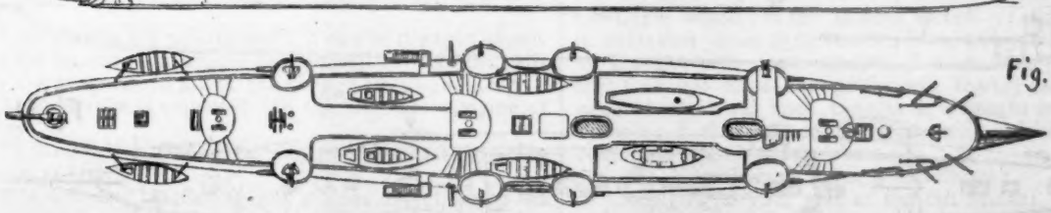


Fig. 7.

This ship will have two compound engines, capable of working up to 9,000 H.P. with forced draft, and of driving the ship 20 knots an hour. With a full supply of coal the cruising radius, at 12 knots an hour, will be 4,000 knots.

The armament will consist of four 16 cm. (6¼-in.) guns —one forward and one aft—on pivot carriages, and two in

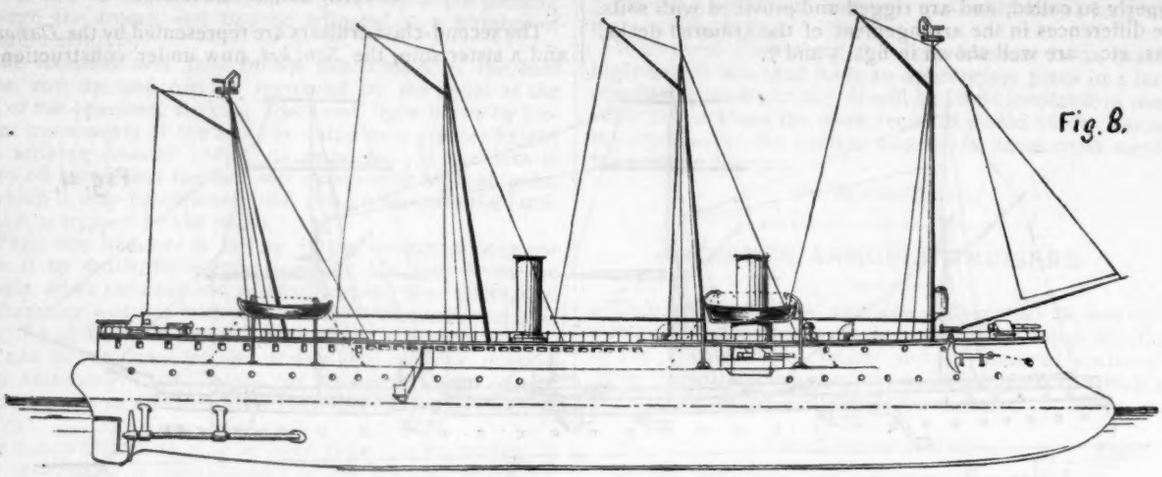


Fig. 8.

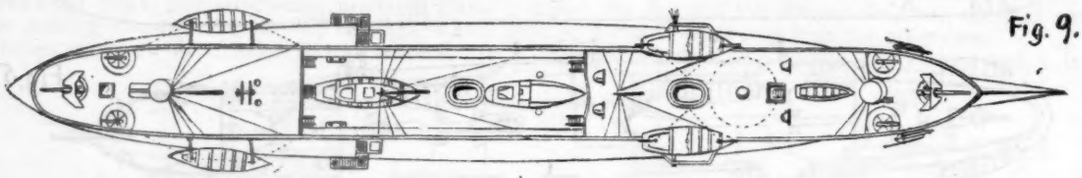


Fig. 9.

the casemate on the upper deck; four rapid-fire guns, two forward and two aft, and six 37-mm. (1½-in.) revolving cannon mounted in broadside.

Two similar vessels—the *Chanzy* and the *Mogador*—are to be built, the contract for them having been let to the Société de la Loire.

THIRD-CLASS CRUISERS.

The new third-class cruisers are all of the type of the *Forbin*, shown in figs. 10 and 11, and the plans were prepared by M. de Bussy. In all, six of these ships are ordered or under contract. The *Forbin* is building at the Rochefort navy-yard and the *Surcouf* at the navy-yard at Cherbourg; the engines for both are to be built by the Société de la Loire. The Société Transatlantique will build both ship and engines of the *Coetlogon* at Brest, while for the other three—the *Froude*, the *Lalande* and the *Cosmao*—contracts have been let; for the ships to the Société de la Gironde at Bordeaux, and for the engines to the Creusot Works. These three will differ very slightly from the others, having 0.20 meter more beam, 0.07 meter less draft, and 30 tons greater displacement—variances hardly perceptible.

The dimensions of the *Forbin*, the typical ship of this class, are as follows:

Length between perpendiculars	95.00 meters.
Greatest breadth	9.30 meters.
Depth of hold midships	6.54 meters.
Draft aft	5.24 meters.
Draft mean	4.24 meters.
Difference in draft, aft and forward	2.00 meters.
Immersed cross-section	31.27 sq. meters.
Total displacement	1,848 tons.

An armored deck 4 cm. thick extends the whole length of the ship, with a strong armored house or casemate over the engine and boiler rooms, protecting the vital parts of the vessel.

The *Forbin* will have two independent, direct-acting compound engines, and six cylindrical boilers, each with two furnaces; the boilers are arranged in two groups of three each.

These engines can work up to 6,000 H.P. with forced draft, and running at 140 revolutions per minute, it is expected that they will drive the ship at the rate of 19.5 knots.

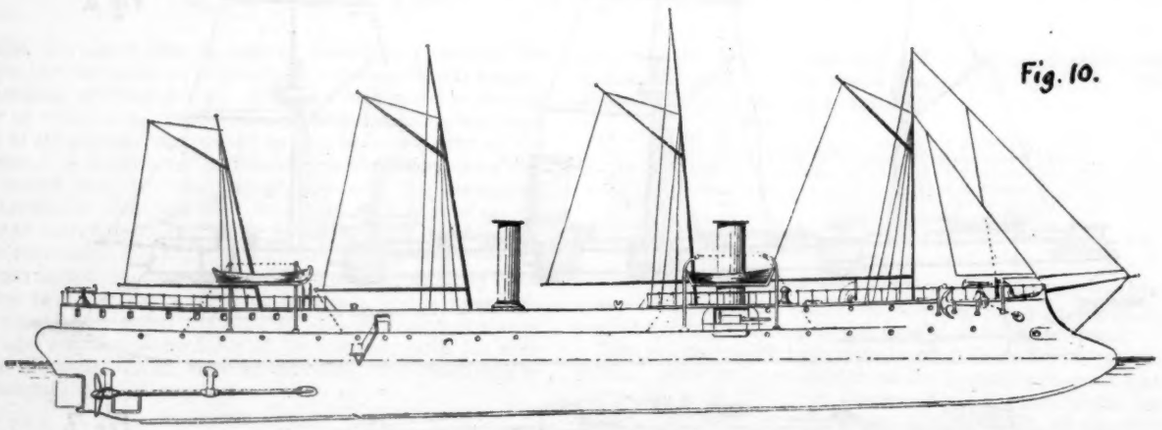


Fig. 10.

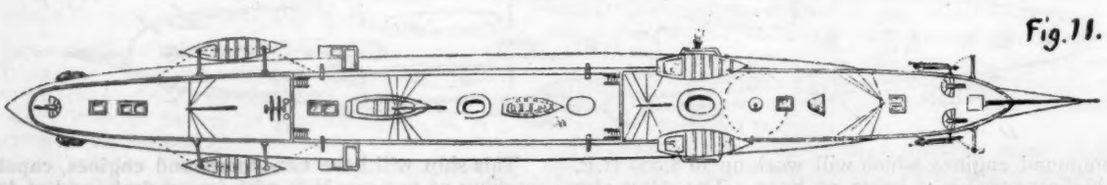


Fig. 11.

With a full supply of coal, and at a speed of 10 miles an hour, the cruising range of this ship is 2,400 knots.

The armament will consist of two 14-cm. (5½-in.) cannon, mounted on pivot carriages in the casemate forward; three 47-mm. (1.85-in.) rapid-fire cannon, two on the forecastle and one aft, and four revolving cannons in broadside in small turrets.

These third-class cruisers will be, it is expected, very useful vessels, and they will be hurried to completion as fast as possible.

STANDARD TIME AND THE 24-HOUR SYSTEM.

AT the annual meeting of the American Society of Civil Engineers in January, the special Committee on Uniform Standard Time, of which Mr. Sandford Fleming is Chairman, presented an interesting report showing the progress of the Time Reform proposed by the Society. This report is given in full below:

The last annual report of the Committee referred to action which had been taken by the General Time Convention the year previous, with the view of securing an expression of opinion from that Association on the subject of the 24-hour notation.

Circulars had been sent out by the Secretary of the General Time Convention directing attention to the contents of a pamphlet issued by the American Society of Civil Engineers, setting forth the experience which up to that date had been gained on the Central and Mountain Divisions of the Canadian Pacific Railway, where the new notation had been in use for some months. A series of questions also accompanied the circular, to which members of the General Time Convention were requested to furnish replies.

The replies were referred to in the last annual report of this Committee, where, among other things, it was stated that 61 affirmative and 38 negative replies had been received in reference to the question, "Are you in favor of the general adoption of the 24 o'clock system of counting the hours—abandoning the use of A.M. and P.M. ?"

It was deemed important to ascertain the precise character of the 38 negative replies, and accordingly application was made to the Secretary of the General Time Convention, Mr. W. F. Allen, for copies of the objections which had been offered. Through the courtesy of that gentleman, the information has been received since the last Annual Meeting of this Society.

An examination of all the replies containing objections shows the following expressions of opinion—viz.:

6 That the A.M. and P.M. system is good enough.
5 That there is nothing to be gained by the change.
4 That the people should be educated to the new system before the railways adopt it.
3 That the adoption of the change would cause great confusion.
2 That it will be impossible to get men to understand the new notation.
2 That it is advisable to delay adopting the new notation until more experience is gained on the railroads now using it.
2 That doubts are entertained if it can be brought about.
2 That its adoption should be delayed until all the railroads are prepared to adopt the change simultaneously.
1 A preference is expresed for the decimal division of the day.
1 That midnight should be designated ZERO or O, in place of 24 hours.
1 Has difficulty in offering any serious objections to the new system.
1 Does not think it concerns the public very much.
1 That it is for the Government to authorize the adoption of the new notation rather than the railroads.
1 Is of opinion that the change would involve great expense.
1 That there will be some objection to the change whenever it may be made.
1 Is not sufficiently familiar with the working of the new system.

The deductions from this analysis are, that of the 99 railroad managers who in April, 1887, furnished replies to the questions placed before them, there were only six who considered the A.M. and P.M. system good enough, and only five who were then unable to recognize the advantages of the new notation. That the objections were not considered very serious by the writers of them is evident from the fact that in 21 of the 38 negative replies, it is stated that they will be prepared to adopt the 24-hour notation if the connecting lines do the same.

The objections which have been raised are met in the most convincing manner by letters from railroad men who have now had from two to three years' daily experience in the use of the new notation in operating railroads. These communications are placed at the service of the Committee and comprise the following—viz.:

15 Letters from managers, assistant managers, superintendents, and assistant superintendents.
7 Letters from train dispatchers.
8 Letters from conductors.
25 Letters from stationmasters.
18 Letters from trackmasters and track foremen.
2 Letters from yardmasters.

There is a singular unanimity of opinion expressed in all these letters in favor of the new system. At present, your Committee cannot do better than submit the two communications which have been last received:

1. A letter from Mr. Collingwood Schreiber, General Manager of the Intercolonial Railway of Canada, dated January 9.

2. A letter from Mr. W. C. Van Horne, President of the Canadian Pacific Railway, dated January 10.

1. Mr. Schreiber's letter is as follows:

"I have your letter of yesterday's date, making inquiry as to whether or not the 24-hour system of time notation is still in use upon the Government Railways, and if so, desiring to be informed if it gives satisfaction.

"In reply I may say, the 24-hour time notation was introduced upon the Intercolonial Railway (906 miles) and the Eastern Extension Railway (80 miles) on June 13, 1887; that it has been in most successful operation from that date to this. I anticipated at the time some trouble in having such a novelty introduced, imagining the public press and the employés of the road would combat it, but such has not been the case; not a word of complaint, so far as I am aware, has appeared in the newspapers upon the subject, and our officers and employés, as a rule, appear to view it as an advancement in the right direction, those employés immediately connected with the movement of the trains especially favoring the system. Under this time notation system no confusion can arise, and for this reason greater safety is assured.

"For my own part I may say I am strongly in favor of the 24-hour system of time notation, and I propose, so soon as the Oxford & New Glasgow Railway (70 miles), and the Cape Breton Railway (100 miles), now under construction, are completed and turned over to the Operating Department, to extend the system to those lines. I think it would be an advantage if it was more generally used by the railways, and I hope, at no distant day, to see its use very much extended; in fact, it appears to me it would be a great advantage if the railway managers throughout the Continent would put the 24-hour system of time notation in operation upon their roads; it certainly could not but be fraught with good results. I may, however, remark that I do not think the public will readily take it up for general use until such time as it is taught in the public schools; if this was done, I believe it would very soon come into use for all purposes."

2. Mr. Van Horne's letter is as follows:

"Replying to your note of the 6th instant, I am happy to be able to say that our nearly three years' trial of the 24-hour system on all of our lines west of the Great Lakes, embracing 2,354 miles, has been highly satisfactory. No confusion whatever resulted from its adoption or has grown out of its use, and I have yet to hear of the first objection to it on the part of the public.

"The Manitoba & Northwestern Railway Company, 207 miles, and the Northwestern Coal & Navigation Company's

railway, 110 miles, also follow this system. It is, therefore, the only system used for railway purposes north of the 49th parallel and west of the 89th meridian.

"We hope soon to be able to extend this system over all the company's lines in the East. We should have done so before this time, if some of our neighboring lines had been in a position to join us in the movement.

"A short experience with it must, I believe, convince anybody that it is vastly superior for railway purposes to the old system. It takes a surprisingly short time to come to think of 20 o'clock instead of 8 o'clock P.M.

"There is no danger in its adoption, even on a very busy line. The term 19:47, for instance, in a train order, cannot be mistaken for anything else."

CONCLUSIONS.

These letters conclusively establish that the new notation has been thoroughly tested for two or three years on 3,657 miles of railway; that no difficulty whatever has been experienced in introducing the change; that it has been readily accepted by the public without a single objection being heard; that its extreme simplicity and the impossibility of errors resulting from its use facilitates the movements of trains and promotes the public safety. The new system having thus proved so satisfactory in every way, it has now been determined to employ it on 3,053 additional contiguous miles, which will make a total length of 6,710 miles of railroad shortly to be operated under the new notation.

It is obvious that there can no longer be any doubt as to the practical advantages of the new system, and the ease with which it can be applied to the operating of any line of railroad. The negative replies which have been cited cannot be said to present insuperable difficulties, and it is believed that the writers of them will now have their views greatly modified by the experience which has been gained, and the explanations made in the more recent letters which have been submitted.

Your Committee cannot but think that in the public interest it is advisable that renewed efforts be made to secure the general adoption of the new notation.

TRANSITION CURVES.

By Charles Davis Jameson, C.E.

In laying out a line of railroad, the angles formed by the meeting of two adjacent tangents are rounded off by means of a curve of some class of sufficiently long radius and of proper form to allow of the free passage of trains without danger and with a minimum of inconvenience.

A circular arc is the form of curve most generally used, and the methods employed in laying it out have been fully explained in Chapter XIX., "Principles of Railroad Location," published in the Journal for May, 1888.

Curves of other forms, such as the parabola, have been used to some slight extent, but the various disadvantages connected with their use are such that the circular curve, with some slight modifications, will continue to be *the* railroad curve. The advantages of this curve over any other for railroad work are as follows:

1. The change of direction is uniform throughout its whole length.

2. The ease and facility with which it can be laid out in the field.

Any body, such as a railroad train, acted on by one force only, tends to move in a straight line, and it requires another constant force acting at an angle with the original force to cause the body to move in a curved path.

In the case of a railroad train, the curved path is defined by the rails to which the train is held by means of the wheel flanges, and the change of direction in the train in passing around a curve is effected by means of these flanges pushing against the outside rail. The amount of this pressure is the force required to make the train follow the curve, and thus overcome the tendency it has to move in a straight line, or the centrifugal force. The amount of this pressure varies with the speed of the train and the radius of the curve. The formula for it is:

$$F = m\frac{v^2}{r} \qquad (1)$$

F = the centrifugal force.
r = the radius of the curve at the given point.
v = velocity of train in feet per second.

The value of F varies with r, and when r is constant F is constant also. Therefore F, or the amount of pressure on the outside rail, is constant throughout a circular curve. This centrifugal force not only causes a pressure of the wheel flanges against the outside rail, but as the center of gravity of the car is much above the point of support, there is a tendency to turn over toward the outside rail.

In order to reduce somewhat this pressure of the flanges against the outside rail, and also to eliminate the danger of the cars being turned over by centrifugal force, it is the universal custom to raise the outer rail on a curve a certain distance above the inner one.

When the outer rail has a greater elevation than the inner one, the tendency of the train will be to turn over on the side of the lower rail, which in the case of curves would be toward the inside of the curve. When a train is passing over a curve at a certain velocity, this velocity, together with the change of direction of the curve, produces a certain amount of centrifugal force which tends to turn the train over toward the outside of the curve. The theoretical amount of superelevation to be given to the outside rail is such that, at the assumed velocity of the train, these two forces, one throwing the train to the inside of the curve and one to the outside, will exactly counterbalance each other, and the train will remain in perfect equilibrium while passing around the curve.

In other words, the lateral component of gravity thus introduced by the superelevation of the outer rail will approximately balance the centrifugal force due to the speed of the train and the radius of the curve. The theoretical elevation to produce this effect is given by the equation:

$$E = \frac{g\,v^2}{32.2\,R}.$$

Here E is the superelevation, v the velocity of the train in feet per second, g the width of gauge, and R the radius of curvature.

From this it can be seen that the superelevation is constant for constant values of D or r.

In actual practice the amount of superelevation that may be given to the outer rail is limited, for the following reasons:

1. The unavoidable variation in the speeds of the different trains, and the fact that when the superelevation becomes too great there is a tendency for slow freight trains to become derailed upon the inside of the curve.

2. That no matter how much superelevation is used, there is a safe limit beyond which trains cannot be run. This is due to the fact that the car-bodies rest upon springs, and, as the centrifugal force increases, the pressure upon the outside springs increases and they become compressed by a certain amount. As the speed increases, this compression increases, until at last a speed is reached that upon a given curve generates sufficient centrifugal force, and by it sufficient compression upon the outside springs to force the car-body into the same position it would have if there were no superelevation and no curve. The result of this is to reduce the limit of safe speed, and, as the amount of centrifugal force that can with safety be generated is limited by the stiffness of the springs, there is no necessity of any more superelevation than is required to balance this allowable amount of centrifugal force.

The limit that is adopted upon railroads varies from 6 to 10 in. A maximum limit of 8 in. can be taken as approximately correct.

As a rule of thumb to be memorized by the engineer: *The superelevation should be one inch per degree of curvature up to the maximum limit.*

Beyond this limit the speed of the trains should be reduced in order to reduce the centrifugal force.

This amount of superelevation is somewhat in excess of what is generally used, but, owing to the rapid increase that is being made in the speed of trains, it will be found none too much.

For the use of track men who do not know the degree, or radius, of the curves, but have the curves themselves

in the shape of the rails, it is often convenient for them to know the length of the chord in feet, the middle ordinate of which is the correct superelevation of the outside rail. The length of this chord that gives a middle ordinate of 1 in. per degree of curvature is 61.8 ft.; or *four times the middle ordinate of a 30-ft. rail will give approximately the same result.*

In order to obtain the correct superelevation of the outer rail, carefully mark two points upon the inside of the head of the outside rail. The distance between these two points is to be equal to the required length of chord—61.8 ft.

Stretch a small cord tightly between these points, and from the middle point of this cord measure the distance from the cord to the inside of the head of the rail, and this distance will be the correct superelevation of the outside rail.

As we have seen, the amount of this superelevation is uniform for the whole length of a circular curve.

If any curve other than a circular curve is used, the

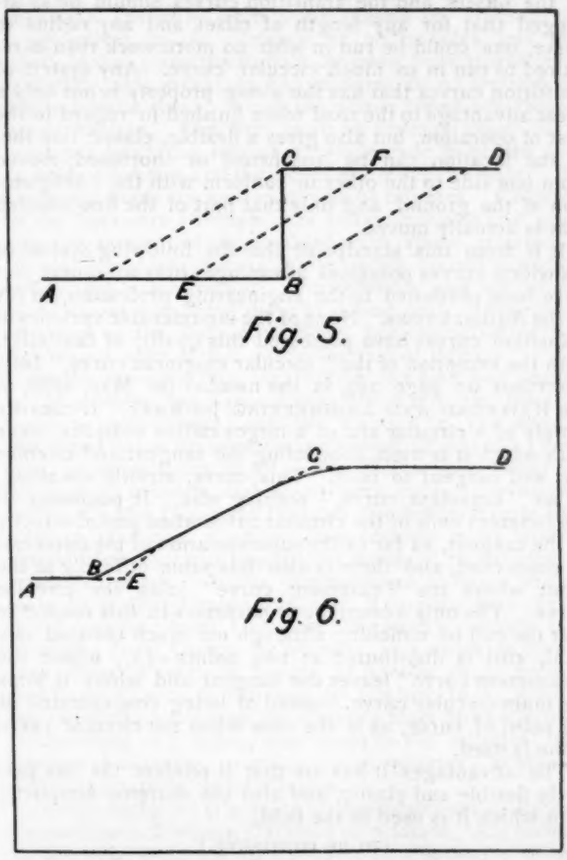


Fig. 5.

Fig. 6.

radius of this curve will vary from point to point, and, consequently, the required amount of superelevation of the outside rail will also vary in the same proportion.

This would necessitate not only a great increase of work and care upon the part of the section-men to give this correct but varying amount of superelevation, but it would be practically impossible to so put the track up as to eliminate all shocks and irregularities in the trains.

In this fact consists the great advantage of the circular curve, and this, taken in connection with the ease and facility with which they can be located, will always insure their general use.

The circular curve, however, as generally used, possesses the following disadvantages:

The superelevation of the outside rail being constant for the whole length of the curve, at the point where the curve begins the outside rail should have the full superelevation, as *C B*, fig. 5, but upon a tangent both rails have the same elevation, and, consequently, to conform with theory, the entire superelevation should be made at one point, and that at the beginning of the curve. This, of course, is an impossibility, as it would create a step in the profile of the outside rail.

This difficulty is obviated to some extent by one of the three following methods:

1. The superelevation may begin back a sufficient distance upon the tangent to allow of the requisite amount being attained by the time the curve commences, as *A C*, fig. 5.

2. The superelevation may begin at the point of curve, and be increased as rapidly as possible until the requisite amount is attained at some point on the curve, as *B D*, fig. 5.

3. The superelevation may begin a sufficient distance back on the tangent to allow of about one-half the requisite amount having been attained when the point of curve is reached, and this amount to be gradually increased until the full requisite amount is attained at some point in the curve, as *E F*, fig. 5.

These are only partial remedies. The first has the objection of making one rail higher than the other upon a tangent, which causes the train to crowd against the lower side.

The objection to the second is that a portion of the curve at each end has a very insufficient amount of superelevation.

In the third there is about half the objection of the first plus half the objection of the second, and any way it can be adjusted, there exists in some form about the same amount of evil in regard to the superelevation of the outside rail, when the circular curve is joined directly to the tangent.

There is also not only the trouble in regard to the superelevation of the outside rail, and the shock and jar thereby caused the train, but where the circular curve is joined directly to the tangent the change of direction in the case of a sharp curve is relatively so great at the point of curve as to cause a great shock to be felt in the train, no matter what the elevation of the outside rail may be. This in some cases is so great as to become a source of real danger.

After the train has passed entirely upon the curve and the proper superelevation is once attained, then it is in as perfect equilibrium as upon a tangent, and there is no cause for any inconvenience or unsteadiness in the running.

These two disadvantages connected with the use of circular curves are confined to portions only of the curve near and at its ends, and are due to the fact that the circular curves are joined directly to the tangent. They exist simply in regard to a too sudden change in direction, and in the impossibility of giving the outer rail the correct superelevation at the right point. In order to obviate these evils, TRANSITION, or EASEMENT CURVES have been introduced, by means of which the circular curves are joined to the tangents.

The necessity and utility of easement or transition curves is very readily seen if a careful examination is made of a piece of road that has been built for a number of years, over which there has been the passage of a great many trains, and which has been lined all the time by section-men. It will always be found that although the curves in the beginning were perfect circular curves, joined directly to the tangent, still, as time goes on, the circular curves near each end invariably become changed into a rude form of transition curves. This is due to the impact given to the outside rail at the beginning of the curves by the sudden change in the direction of the train, and also to the gradual easing off of the curve unconsciously done by the track-men. In any easing off of the ends of a circular curve that has been joined directly to the tangent, while at the point of curve the radius may be increased somewhat, this increase can only be effected by a proportional shortening of it at some point beyond, and thus what is gained at one point is nearly all lost at another. As an example showing how universal is this unconscious introduction of easement curves upon old roads, the Author once had occasion to make a survey of 271 miles of railroad which had been operated some 25 years. A survey was made with the object of getting the alignment exactly as it was at that time, and all the curves showed clearly upon being plotted that their ends had been eased off, and a sharp point created a certain distance beyond on the curve. This was the case without exception upon every curve. In some cases the track, by means of the impact given by passing trains, and the help given to this impact by the section-men, had been moved a distance of three

or four feet from its original position, thus necessitating a continual widening of the road-bed upon the outside of the curves near their ends.

This excessive width of road-bed at these points was the first thing that called the Author's attention to the fact.

This establishes beyond a doubt the necessity and economy of some class of easement curve, but does not introduce one that in every way conforms with the required conditions. An immense amount of wear, tear, and time are necessary in this method of introducing them. Some method must be found that shall conform practically and theoretically with the required conditions, by means of which the rails may be laid in the proper position in the beginning.

The necessity of the transition curve was not so marked in the early days of railroading as at present, owing to the extremely slow rate of speed at which most of the trains

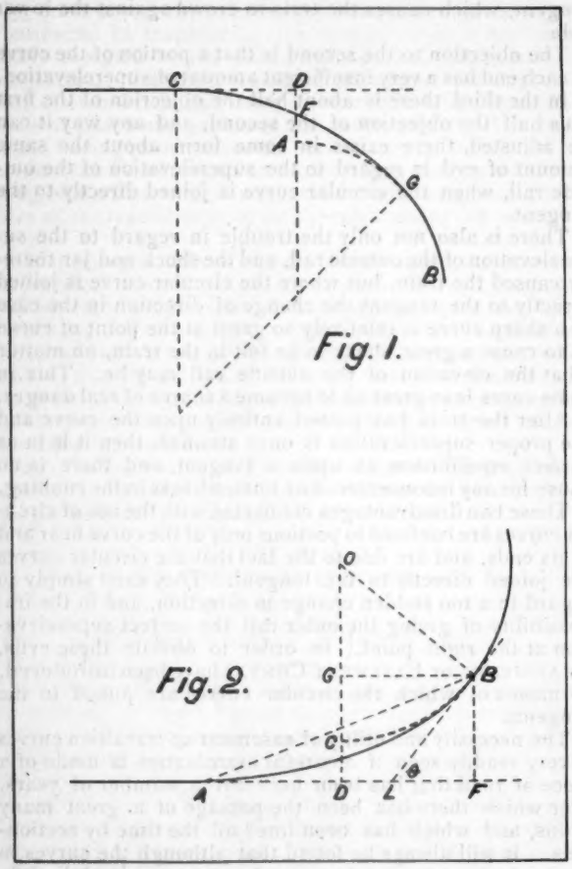


Fig. 1.

Fig. 2.

were run, but with the speed of the present day they are almost an absolute necessity.

A theoretically perfect transition curve should possess the following properties :

1. Beginning with a radius that is practically infinity, this radius should gradually decrease until it becomes equal to the radius of the desired circular curve.

2. The radius of a transition curve should vary inversely as the distance from the starting-point, although not necessarily in exactly the same inverse ratio.

These are the theoretical requirements, and to these should be added the following practical requisites :

Every transition curve of whatever form consists essentially of the following parts, fig. 1 :

The tangent *C D* is run up to a certain point, as *D*, where it is desirable to put in a curve, and then instead of the circular curve being connected directly with the tangent, it is moved in so as to form an offset, as *D A*, and the circular curve occupies the position *A G B*. The transition curve connects this circular curve with the tangent. It starts at some point on the tangent back of *B*, such as *C*, it passes approximately through the middle point in the offset *F*, and is tangent to the circular curve at some point beyond *A*, as at *G*.

All transition curves are of this form, more or less, and the most important practical point to be considered is that the offset *D A* should not be of any fixed length for a circular curve of a given radius, but should be capable of being varied in length to suit more nearly the surface of the ground. This fact, that the offset *D A* is not fixed in length by the radius of the circular curve, not only allows of the line being fitted more accurately to the ground when first run, but also renders it possible to change the position of any portion of the line afterward without the necessity of rerunning and changing all that has gone before or after.

That is, if after the final location has been made and the circular curves run in, it is found that the line can be improved by changing the position of any of these circular curves, within certain limits, or by changing their radius, any of these changes can be made without changing the position of the tangents at each end of the curve. The only change that would be made would be in the length of the offsets, and the transition curves should be so arranged that for any length of offset and any radius of curve, one could be run in with no more work than is required to run in so much circular curve. Any system of transition curves that has the above property is not only a great advantage to the road when finished in regard to the cost of operation, but also gives a flexible, elastic line that in the location can be lengthened or shortened, moved from one side to the other to conform with the configuration of the ground, and only that part of the line affected that is actually moved.

It is from this standpoint that the following system of transition curves possesses advantages over all others that have been presented to the engineering profession, so far as the Author knows. None of the innumerable varieties of transition curves have possessed this quality of flexibility, with the exception of the "circular easement curve," fully described on page 249, in the number for May, 1888, of the RAILROAD AND ENGINEERING JOURNAL. It consists simply of a circular arc of a larger radius than the curve with which it is used, connecting the tangent and circular arc and tangent to both. This curve, strictly speaking, is an "easement curve," nothing else. It possesses all the inherent evils of the circular curve when joined directly to the tangent, as far as the superelevation of the outer rail is concerned, and there is also this same difficulty at the point where the "easement curve" joins the circular curve. The only advantage it possesses in this respect is that the evil or difficulty, although not much reduced as a total, still is distributed at two points—*i.e.*, where the "easement curve" leaves the tangent and where it joins the main circular curve, instead of being concentrated at the point of curve, as is the case when the circular curve alone is used.

The advantages it has are that it renders the line perfectly flexible and elastic, and also the extreme simplicity with which it is used in the field.

(TO BE CONTINUED.)

THE STRONG LOCOMOTIVE.

A REMARKABLE test of the capacity of this locomotive for continuous work was recently made. On April 1 the locomotive *A. G. Darwin*, owned by the Strong Locomotive Company, which has been running for some time on the New York, Lake Erie & Western Railroad, started from Jersey City with the regular day express of that road, and made the run through to Buffalo, 423 miles. This is the longest continuous run ever made with one locomotive of which we have any record, with the exception of a trip from Jersey City to Pittsburgh, which was made with a single locomotive some years ago. On the following day, April 2, the *Darwin* made the return trip from Buffalo to Jersey City in the same way.

On both days the engine arrived at its destination in excellent condition, requiring no repairs whatever, and apparently in condition to go out again at once. The trip also was made in both directions on time, in spite of delays caused by stopping to take on coal, and one serious delay

on the west-bound trip caused by the necessity of pushing a disabled freight train, which was overtaken, to the next siding. The coal was that ordinarily burned on the road, and was not of very good quality. In fact, it clinkered considerably, and on the arrival in Jersey City the second day, the tube sheet was found to be badly coated with clinkers, thus impairing the draft considerably.

The ability of the engine to keep an abundant supply of steam, as it did throughout these long runs, was undoubtedly due to the double fire-box, which is the distinguishing characteristic of the boiler, and which enables the fireman always to have one good clear fire in use, no matter how poor the condition of the other might be. The figures for time, distance, etc., from the official record are given below:

On the westward trip the Eastern Division from Jersey City to Port Jervis (87½ miles) was covered in 151 minutes, or 6 minutes less than schedule time; the Delaware Division, from Port Jervis to Susquehanna (104½ miles), in 166 minutes, or 11 minutes less than schedule time; the Susquehanna Division, from Susquehanna to Hornellsville (139¾ miles), in 187 minutes, or 20 minutes less than schedule time; and the Buffalo Division, from Hornellsville to Buffalo (92½ miles), in 130 minutes, or 27 minutes less than schedule time. All of the above times are those of actual motion. The first is at an average speed of 34¾ miles per hour, the second 37¾ miles per hour, the third 45 miles per hour, and the fourth 42½ miles per hour. The total time made up westward was 64 minutes. Callicoon, on the Delaware Division, was left 20 minutes late, going west, on account of the disabled train above referred to, 18 minutes of which were made up on arrival at Susquehanna, 56½ miles distant. Hornellsville was left 20 minutes late, on account of delay in taking coal. Other delays occurred on the Buffalo Division, but the schedule time was struck near Alden, 19½ miles east of Buffalo.

On the eastward trip, the Buffalo Division was covered in 155 minutes, the Susquehanna in 208 minutes, the Delaware in 159 minutes, and the Eastern in 141 minutes. The times made up were respectively 8, 18, 21, and 13 minutes, or 60 minutes in all. The fastest mile noted was made in 55 seconds, and many were made in 60 seconds each. On the Delaware Division the distance from Callicoon to Hancock, 28 miles, was covered in 34 minutes, and from Hancock to Deposit, 13 miles, in 20 minutes, the grade being up. On the Susquehanna Division the distance from Binghamton to Union, 8.6 miles, was covered in 12 minutes; from Union to Owego, 13.4 miles, in 17 minutes; from Owego to Waverly, 19.1 miles, in 23 minutes; from Waverly to Elmira, 17.6 miles, in 22 minutes, and from Elmira to Corning, 17.3 miles, in 25 minutes. On the Buffalo Division the distance from Hornellsville to Canaseraga, 12.5 miles, was made in 18½ minutes; from Castile to Warsaw, 10 miles, in 15 minutes; Warsaw to Attica, 17.2 miles, in 22 minutes.

On the eastward trip some of the speeds are as follows: Susquehanna Division, Canisteo to Addison, 25.9 miles, in 35 minutes; Addison to Corning, 11.1 miles, in 18 minutes; Corning to Elmira, 17.3 miles, in 24 minutes; Elmira to Waverly, 17.6 miles, in 23 minutes; Waverly to Owego, 19.1 miles, in 24 minutes; Owego to Union, 13.4 miles, in 19 minutes. On the Delaware Division rates of speed were as follows: Deposit to Hancock, 12.7 miles, in 18 minutes; Hancock to Callicoon, 28 2 miles, in 36 minutes; Cochecton to Lackawaxen, 19.9 miles, in 26 minutes. All of the above intervals are from a start to a stop.

The trains consisted of the following cars and weights, without the locomotive and passengers: Jersey City to Port Jervis, 6 cars, including 2 Pullmans, weighing 132 tons; Port Jervis to Elmira, 7 cars, including 2 Pullmans, weighing 154 tons; Elmira to Hornellsville, 9 cars, including 3 Pullmans, 214 tons; Hornellsville to Buffalo, 7 cars, including 3 Pullmans, 209 tons; Buffalo to Hornellsville, 8 cars, including 3 Pullmans, 233 tons; Hornellsville to Elmira, 11 cars, including 5 Pullmans, 335 tons; Elmira to Jersey City, 9 cars, including 4 Pullmans, 274 tons. The locomotive weighs 68 tons in working order, and the tender 40 tons, full of coal and water.

The maximum grades encountered were 8 miles of 60 to 90 ft. per mile from Susquehanna eastward, and one of 54 ft. per mile for 13 miles from Port Jervis eastward, both of which were ascended without assistance.

EXPERIMENTAL GUNS FOR THE ARMY.

THE late Congress appropriated $6,000,000, to be expended at the rate of $2,000,000 a year in the purchase of new guns for the coast defenses. Under the act a Board on Ordnance and Fortification was appointed to decide on the method of using the appropriation. The act provides that this Board shall prescribe the dimensions and method of testing guns of 10 or 12-in. caliber that may be submitted by private parties, and if any gun offered shall fulfill the requirements as to accuracy, range, power, endurance, and general efficiency, then the gun and ammunition (which is to be furnished with the gun) shall be paid for at a fair valuation, including cost of transportation. A contract is also to be made at reasonable prices with the party presenting the best of such guns for a further supply.

The Board has prepared and published rules to govern the tests, which are as follows:

RULES.

1. The 10-in. gun shall be about 30 tons (long) in weight, the length 34 calibers, measured from the face of the obturator to the face of the muzzle. It is desirable that the trunnions be 12 in. in diameter and the distance between rim bases 42 in., in order to avoid the necessity for a special carriage. The power must be a muzzle energy of not less than 15,000 foot-tons; the range shall, for 20° elevation, be 13,650 yards, and corresponding ranges shall be obtained with lower elevations. The requirements as to accuracy are that 25 per cent. of the shots shall strike within a vertical rectangle, 1.4 ft. by 1 ft. at 1,500 yards' range, and within a horizontal rectangle, 48.5 yards by 9 2 yards at 10,000 yards' range.

2. The endurance test should not be less than 300 rounds with full charges. After 250 or more rounds may have been fired, the gun may be lined wholly or in part, when at least 50 rounds more will be fired to fully test the strength of the construction. After this the general soundness and efficiency of the gun should not be materially impaired, except so far as may have resulted from erosion. Should any material modification of the construction be made during the trial, at least 50 rounds, with full charges, shall be fired thereafter. The weight of projectile to be used with the full charge shall be about 575 pounds. Three hundred rounds of ammunition shall be the "proper" amount to be supplied with the gun for test.

3. As a proof of general efficiency, the breech mechanism should work freely and be convenient for operating, the opening and closing of the breech to be performed without great difficulty by one man. The projectiles shall admit of being readily handled, inserted and centered in the bore and not be subject to injury or deformation either in handling or transportation. A rapidity of fire of 15 rounds per hour shall be attainable, using such appliances for loading as are employed by the Ordnance Department, United States Army. The repairs allowable during the entire trial of a gun, exclusive of the insertion of a lining tube, will be confined to repairing or renewing parts injured during trial. No alterations that may affect the general construction of any part will be made without the sanction of the Board.

4. For the 12-in. gun the weight is to be about 52 tons, the bore 34 calibers long, and it is desired that the trunnions be 14.5 in. in diameter and 49.8 in. between rim-bases. The power is to be not less than 26,000 foot-tons, the range 14,700 yards at 20° elevation; the accuracy the same as the 10-in. gun, endurance not less than 250 rounds (a lining may be inserted after 200 rounds), the weight of projectile about 1,000 pounds, and the other conditions are to be the same as in the case of the 10-in. gun, except that a fire of 10 rounds per hour shall be attainable.

5. The experimental guns should be submitted for test as soon as practicable and within three years from date.

It is not considered practicable for the Board to determine at this time what will be a "fair valuation" of

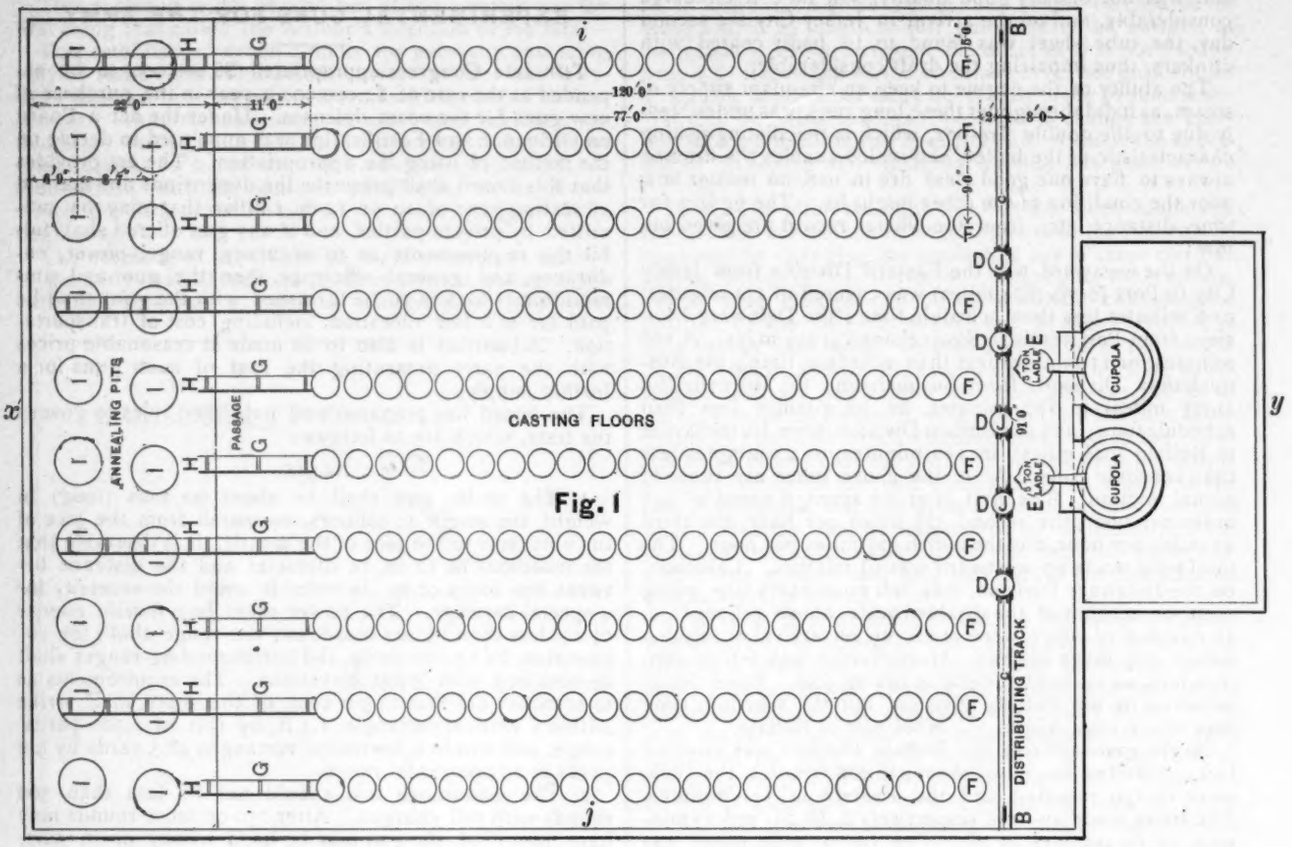
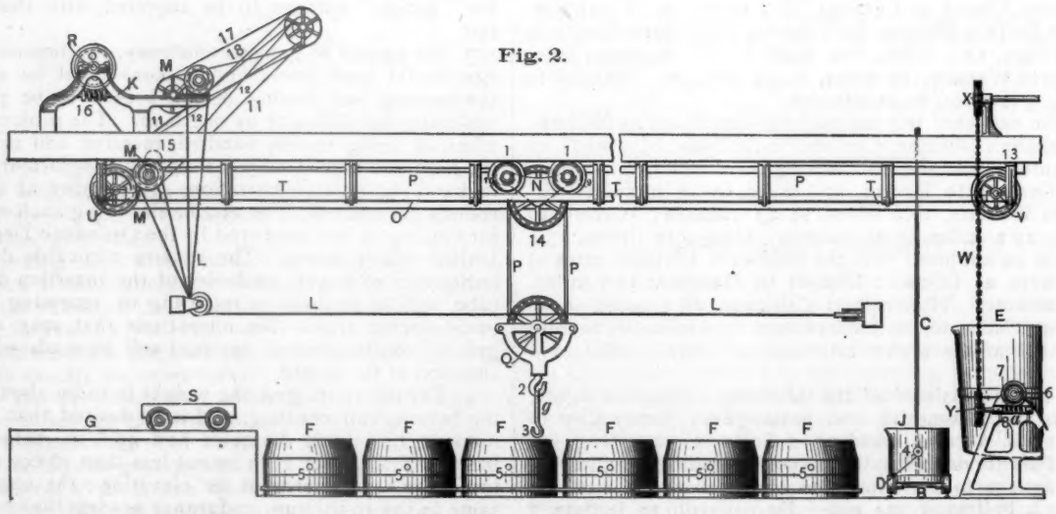


Fig. 1

Fig. 2.

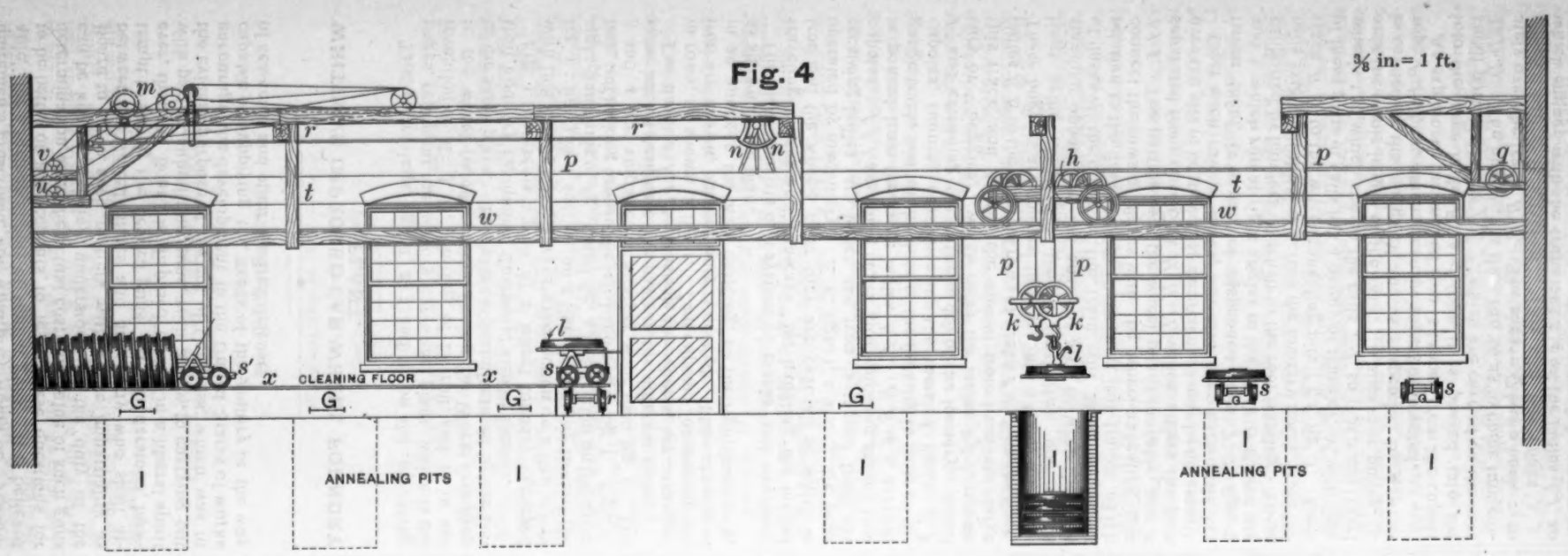


CAR-WHEEL FOUNDRY PLANT,

BY THE DETROIT FOUNDRY EQUIPMENT COMPANY.

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Fig. 4



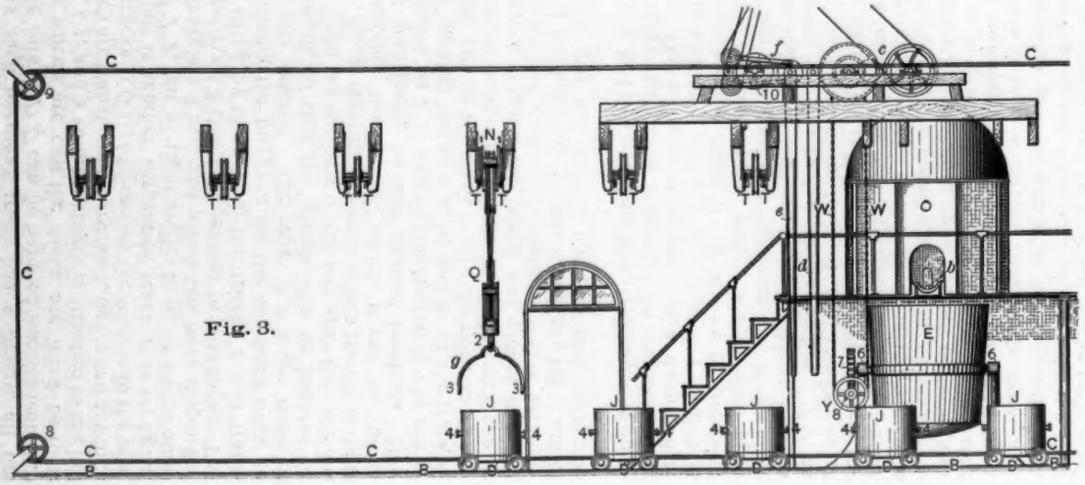


Fig. 3.

CAR-WHEEL FOUNDRY PLANT,

BY THE DETROIT FOUNDRY EQUIPMENT COMPANY.

an experimental gun which shall have fulfilled the requirements prescribed, nor what price would be "reasonable" for a further supply of similar guns. It is believed to be better on all accounts to leave these questions for determination after the actual cost and value of such guns can be known, it being understood as the duty of the Board to act in such matters with entire impartiality as between the United States and any party who shall attempt to supply the desired guns. It is understood, however, that the Board is disposed to deal in a liberal spirit with parties submitting guns, with a view to carrying out the evident purpose of the act of Congress, which was to encourage the development in the United States of works capable of supplying the needs of the country in the way of sea-coast and other kindred defenses.

WHITING'S IMPROVED CAR-WHEEL FOUNDRY PLANT.

THE engravings, figs. 1, 2, 3 and 4, on the preceding pages, represent the foundry car-wheel plant, which is the invention of Mr. J. H. Whiting, of Detroit, and is in use in the wheel foundry of the Detroit Car Wheel Company of the same place. This plant is manufactured by the Detroit Foundry Equipment Company, also of Detroit.

Fig. 1 represents a plan of a wheel foundry equipped with this plant; fig. 2, a transverse section on a line *x y* of fig. 1; fig. 3 is a section on a line *i j*, looking toward the right-hand side of fig. 1, and fig. 4 is a section on the same line, but looking toward the left-hand side of fig. 1. Figs. 2, 3 and 4 are engraved to a larger scale than fig. 1. The same letters designate like parts in the different views.

The flasks *F F F*, for casting the wheels, are arranged in rows, as shown in fig. 1. Two cupolas for melting the iron are shown, but one only is needed. They are placed in an annex to the main building, on the right-hand side, as shown in the plan.

The plant consists of a system of tracks and overhead traveling cranes or "runways" for handling the melted iron and the wheels after they are cast, all of which is operated by machinery. *E E*, figs. 1, 2 and 3, are 5-ton receiving ladles into which the iron is tapped from the cupolas. *J J J* are small ladles into which the melted iron is poured from the large ladles *E E*. *B B* is a narrow-gauge track, laid on the floor of the foundry in front of the cupolas, running crosswise to the rows of flasks *F F F*, and extending the entire width of the foundry. Small cars or "buggies," which carry the ladles *J J J*, run on this track, and deliver the melted iron from the large ladles *E E* to the different rows of flasks *F F F* on the floor. These buggies are coupled together into a train, the couplings being of such a length that when one car is standing opposite to the space or aisle between the rows of flasks all the others in the train will be in a similar relation to the flasks. *G G G* are short iron tracks, which connect the rows of flasks with the wheel-annealing pits *I I I*. The portion over the wheel pits is movable, and is separated from *G G G* at *H H H*, which allows the part over the pits to be moved as desired or as may be necessary.

Over each row of flasks, and also over each aisle between them, is a pair of suspended rails *T T*, figs. 2 and 3, which run at right angles to the track *B B*, and are supported by hangers attached to the roof framing. These rails extend all the way across the foundry floors, from the track *B B* to the wheel-annealing pits *I I I*, fig. 1. Each of these pairs of rails has a buggy or traveler, *N*, with four wheels 1 1, which run on the rails *T T*, so that it can travel over the whole length of the rails. A sheave or pulley, *Q*, is carried by the buggy *N*, and is suspended by a wire-rope *P P P*, by which it can be raised or lowered.

As explained, the melted iron is tapped from the cupola into the large ladle *E*, and from it is poured into the small portable ladles *J J J*, which are carried on the cars *D D D*. The buggy *N* is then run so as to come immediately over the track *B B*. The sheave *Q* has a hook 2, to which a bail *g* is attached. This also has hooks 3 3, which engage with the trunnions 4 4 on the ladles *J J*, so that the ladles can be raised up by means of the wire-rope *P P*. The buggy is then run on the overhead track to any of the flasks in the row, and by attaching suitable handles to the ladle the iron is poured into the flask as may be required. As each overhead track has a buggy, all the ladles on the cars *D D D* can be handled simultaneously.

When the wheels are cast the flasks are lifted by their trunnions 5 5 5, and a suitable clamp is attached to the hot wheels, which are transferred to trucks *S*, figs. 2 and 4, which run on the tracks *G G G*, and convey the wheels to the pits. Over these pits is another suspended track *w w w*, fig. 4, similar to *T T T*, but at right angles to it, on which other buggies or travelers *h* run, and which also have suspended sheaves or pulleys *k k* that are operated by wire ropes. The wheels are lifted by these from the trucks *s*, and transferred by running the buggy *h* on the overhead track to any of the pits desired. The ropes *p p p* are made of sufficient length, so that the wheels can be lowered or raised to or from the bottoms of the pits after they are annealed. *ss'*, fig. 4, represents a truck which travels at right angles to another truck *r*, on which it can be run as shown, and transferred to any desired location. If a wheel is loaded on *s*, it can be transferred to any one of a number of parallel tracks *x x*, by means of the truck *r*; *s* can then be run on the track *x x* to the position *s'*, and by a very simple movement a portion of the truck can be tipped up, which unloads the wheel and places it in an upright position for convenient storing. This arrangement is used for handling wheels which are taken out of the pits while they are still so hot that they cannot be rolled.

It remains to be explained how this mechanism is operated. The large ladle *E* is supported on trunnions 6 6, figs. 2 and 3. One of these trunnions has a worm-wheel 7, which is turned by a screw 8 and sheave *Y*, which is operated by an endless chain *W W*, driven by overhead gearing *c*, the movement of which is controlled by a lever *d*. A boy who stands at the lower end of the lever can cause the ladle *E* to oscillate on its trunnions, so as to pour the melted metal into the smaller ladles *J J J*, as they are run one at a time in front of *E*. The trucks *D D D*, which carry the ladles *J J J*, are connected together into a train, as has been explained; to the left-hand end of the train a wire-rope *C C C* is connected, which is carried to the end of the foundry, and then passes over a sheave or pulley 8, and thence up to another pulley 9, and from there to a drum 10, which is driven by suitable gearing, the movement of which can be governed by a lever *e*. The wire-rope is carried around the drum, and from there to other pulleys, similar to 8 and 9, not shown in the engraving, at the other end of the building, and from these it extends, and is attached to the right-hand end of the train of trucks. When the drum 10 revolves it obviously moves the wire-rope *C C C*, and draws the train of trucks either to the right or the left, according to the direction in which either a crossed or a direct belt causes the drum to revolve. The boy at the lower end of the levers can control these belts, and thus move the small ladles up to the large one, and by tipping it can fill them successively, and then transfer them to any of the rows of flasks on the floor. The buggy *N*, fig. 2, is then run over one of the ladles *J J J*, and the bail *g* is attached to it, by which, as has been explained, it can thus be raised and moved horizontally to any of the flasks below the track on which the buggy runs. *K* represents the machinery by which the traveling cranes are operated. *P P* is a wire-rope, one end of which is attached to the buggy *N* at 9, and then passes around the sheave *V* to the drum *U*, and from there to the opposite end of the buggy, to which it is attached at 10. The drum *U* has suitable gearing, which is driven backward or forward by a straight and a cross-belt 11 and 12. These are shifted by means of horizontal wire-ropes *L L*, which run the entire length of the casting floor, and are placed about 5 ft. 6 in. above it, so that a molder or helper can conveniently move the belts from tight to loose pulleys. In this way the buggy *N* can be moved horizontally in either direction by a person standing at any of the flasks in the rows below the traveling cranes. Another wire-rope is fastened stationary at 13, and from there extends to the sheaves 14 on the buggy *N*, down around the sheave *Q*, and up over one of the sheaves 14, thence horizontally to a small sheave 15, and from there to a drum *R*, which

is operated by a worm 16, and suitable gearing that is also driven by a straight and cross-belt 17 and 18. These belts can be shifted by means of another wire-rope stretched alongside and parallel with *L L*. By winding up the wire-rope on the drum *R*, the sheave *Q* and whatever is suspended to it is raised, and by unwinding the rope, the sheave and its load are lowered. It will thus be seen that both the horizontal and vertical movement of *Q* can be controlled by a person at any position below the traveling crane. A boy at the cupola and one of the molders or his helper on the floor can thus move the melted iron from the cupola to the flask without other help.

The double buggy *h*, fig. 4, for handling the wheels to and from the pits is operated by similar machinery, *m*, to that which has been described, and is controlled by a boy by means of levers *n n* and rods *r r*. The boy occupies an elevated platform above the work to be done, where he can have a full view of it, and can direct the movements of the crane and buggy *h* by moving it back or forth, raising or lowering as may be required. The buggy has two sheaves, *k k*, so that two wheels can be handled at the same time. *l* represents a wheel suspended by the crane ready to be lowered or transferred to any other locality.

It is claimed for this plant that a large amount of labor is saved over any other system now in use; that it enables the molders to pour the metal into the flasks much more quickly than is possible if the iron is not handled in this way, and that much more work can be done on a given floor area than by any other system. At the Detroit Car-Wheel Company's foundry they are now casting 425 wheels per day on a floor area of 12,320 square feet, or a little less than 29 square feet per wheel. They are pouring the iron for each wheel in about a quarter of a minute. Three boys and two men distribute all the iron from the cupola, assist in pouring, and pit the wheels. This is all the labor, besides molders and their helpers, which is employed on the casting floor, and with this plant the reduction in cost of labor in making wheel is from 15 to 25 cents per wheel. The system is also in use at the Fort Madison Iron Works at Fort Madison, Ia. There they have 7,000 square feet of floor area and mold 225 wheels per day, or one wheel to a little over 31 square feet of floor area.

NAVAL NOTES.

THREE bids were received for the construction of the armored coast-defense vessel. Cramp & Sons, of Philadelphia, bid $1,614,000; the Union Iron Works, of San Francisco, $1,628,950; N. Palmer & Company, New York, $1,690,000. The contract has not yet been awarded. This vessel, which was described and illustrated in the JOURNAL for February last, pages 78 and 79, is to be of the *Monitor* type, and of 4,000 tons displacement. She will be 250 ft. in length, 59 ft. in breadth, with a mean draft of 14 ft. 6 in. She will be heavily armored, and will carry an exceedingly powerful armament for her size, consisting of one 16 in., one 12 in., and a number of rapid-fire guns, and a 15-in. dynamite gun. The engines are to work up to 5,400 H.P. The plans of the Navy Department provide for two ordinary return tubular marine boilers, capable of supplying steam for 1,500 H.P., the remainder of the power required to be furnished by coil boilers.

The Secretary of the Navy has approved the report of the trial board on the *Yorktown*, pronouncing the vessel all complete with the exception of the electric light plant. The vessel is, therefore, accepted by the Navy Department, subject to a reservation for the completion of the lighting apparatus.

The *Charleston*, which was built in San Francisco by the Union Iron Works, was to have had her sea trial the latter part of April. The *Charleston*, as has been before noted, is a steel cruiser, 300 ft. in length, 46 ft. breadth, 18 ft. 6 in. mean draft, and 3,700 tons displacement. She is intended to make 19 knots an hour at full speed. The guns of the *Charleston* are now on their way to San Francisco, and she will probably be made ready and sent to sea on her first cruise as soon as possible, her services being much needed on account of the loss of the *Trenton* and the *Vandalia* at Samoa.

The Secretary of the Navy has decided that he cannot grant the application of the Columbian Iron Works, of Baltimore, for an extension of time on the gun-boat *Petrel*. The delay in her completion was mainly due to delays in delivery in material, for which the Secretary holds that the Government was not responsible in any way. Under the law he holds that he has no authority to grant the application.

CATECHISM OF THE LOCOMOTIVE.

(Revised and enlarged.)

BY M. N. FORNEY.

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[*(Continued from page 194.)*]

CHAPTER XXVI.

THE CARE AND USE OF THE AIR BRAKE.*

QUESTION 688. *How should the brake gear be adjusted?*

Answer. It should be adjusted so that when the brakes are full on the pistons in the brake-cylinders of cars will not have traveled less than 7 in. nor more than 9 in. This will allow for wear of shoes, stretching of rods, springing of brake-beams, etc. Great care must be exercised, when taking up the slack in the brake connections, to have the levers and pistons pushed back to their proper places, and the slack taken up by the pins and holes at the top of the dead levers or in the under connections 23, Plate VI, of the levers.

The driving-wheel brakes should be adjusted so that when they are fully applied the piston will run out not less than 2 in. nor more than 3½ in.

QUESTION 689. *Before leaving the engine house what should the engineer observe?*

Answer. He should know whether the engineer's brake-valve, the air-pump, and the other parts of the brake on the engine and tender are in perfect working order, and if not the defects should be promptly reported.

QUESTION 690. *Before coupling to a train what should the engineer do?*

Answer. He should know that the steam-cylinder of the air-pump was properly lubricated with locomotive cylinder oil, and that the air-cylinder is sparingly lubricated with a small quantity of good mineral lubricating oil. Tallow and lard oils should not be used in the air-cylinders.

The air-pump should be started slowly to allow the water which accumulates in the steam-cylinder, from the condensation of the steam, to escape gradually; it should not be forced out by running the pump with full steam pressure. After the pump has made a few strokes put about a teaspoonful of West Virginia mineral oil into the oil cup of the air-cylinder.

Before coupling to the train, the main reservoirs should be pumped full of air of the maximum pressure of 90 lbs., to insure the release of the brakes on the train, and also to be able to charge the auxiliary reservoirs quickly after the engine is coupled to the train.

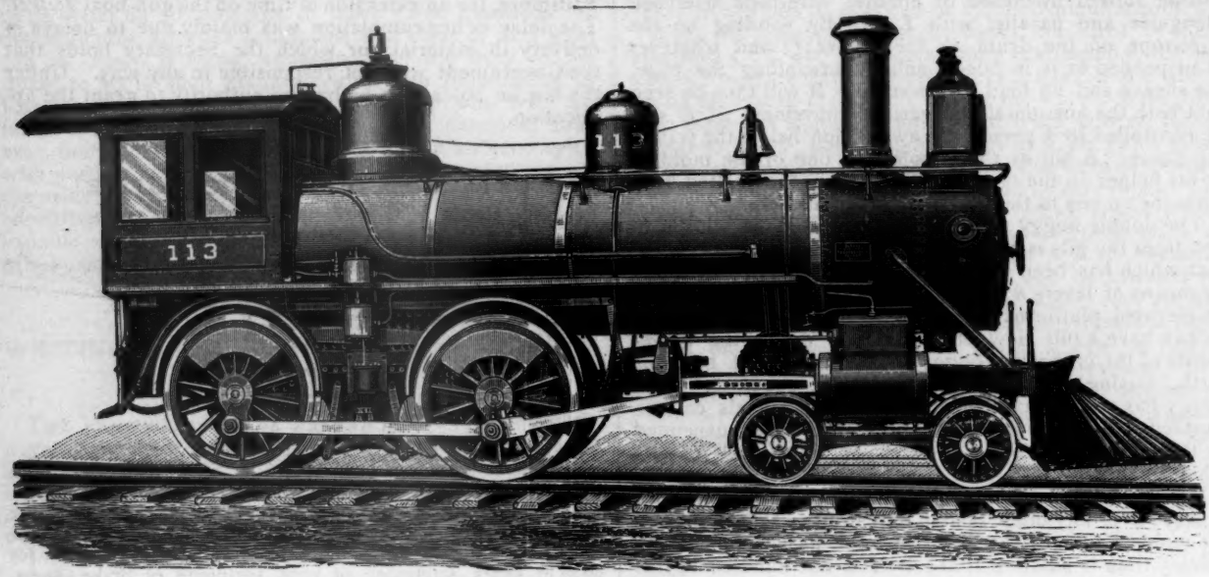
After being connected to the train the handle of the engineer's valve should be turned to the I, or "charging position," until the pressure gauge indicates that the pressure in the train-pipe is equal to 70 lbs. The handle should then be turned to the II position, in order to accumulate an extra pressure of 20 lbs. in the main reservoir.†

The air-gauges which are now supplied for the new automatic brake, as already explained, have two sets of works and two hands—a black and a red one. The black one indicates the pressure in the brake-pipe and the red one that in the main reservoir. The difference of pressure indicated by these hands represents the excess of pressure which is accumulated in the main reservoir over that in the brake-pipe, to aid in releasing the brakes quickly and for recharging the brake-pipe and auxiliary reservoirs. This excess of pressure is accumulated when

* In the answers to the questions in this chapter, free use has been made of the instruction book issued by the Westinghouse Air Brake Company and by some of the railroad companies. The large plate and other illustrations, to which frequent references are made in this chapter, were published in the March and April numbers of the JOURNAL.

† In engraving the large folded plate VI, published in the last number of the JOURNAL, an error was made in numbering the positions of the handle of the engineer's valve 9 in fig. C. The "release position" should have been numbered I, the "running position" II, "closed or on lap" III, "service stop" IV, and "emergency stop" V. By correcting the numbering on the plate, the following description will be made clearer.

CATECHISM OF THE LOCOMOTIVE.



EIGHT-WHEEL "AMERICAN" LOCOMOTIVE.

BY THE HINKLEY LOCOMOTIVE COMPANY, BOSTON, MASS.

Total weight in working order	96,000 lbs.
Total weight on driving-wheels	64,000 "
Diameter of driving-wheels	5 ft. 2 in.
Diameter of truck-wheels	2 " 6 "
Diameter of main driving-axle journal	7¼ "
Distance from center of front to center of back driving-wheels	8 ft. 6 "
Total wheel-base of engine	23 " 0½ "
Total wheel-base of engine and tender	46 " 2¼ "
Diameter of cylinders	17 "
Stroke of cylinders	24 "
Outside diameter of smallest boiler ring	53⅜ "
Length of fire-box, inside	6 ft. 0 in.
Width of fire-box, inside	2 " 11 "
Depth of fire-box, crown-sheet to top of grate	5 " 8 "
Number of tubes	218
Outside diameter of tubes	2 in.
Length of tubes	11 ft. 6 "
Grate surface	17.5 sq. ft.
Heating surface, fire-box	125 " "
Heating surface, tubes	1,230 " "
Heating surface, total	1,355 " "
Exhaust nozzles	Single.
Size of steam-ports	18×1¼ in.
Size of exhaust-ports	18×3 "
Throw of eccentrics	5 "
Greatest travel of valve	5½ "
Outside lap of valve	0⅞ "
Smallest inside diameter of chimney	1 ft. 2 "
Height, top of rail to top of chimney	14 " 1¾ "
Height, top of rail to center of boiler	6 " 8¾ "
Water capacity of tender tank	3,000 gals.

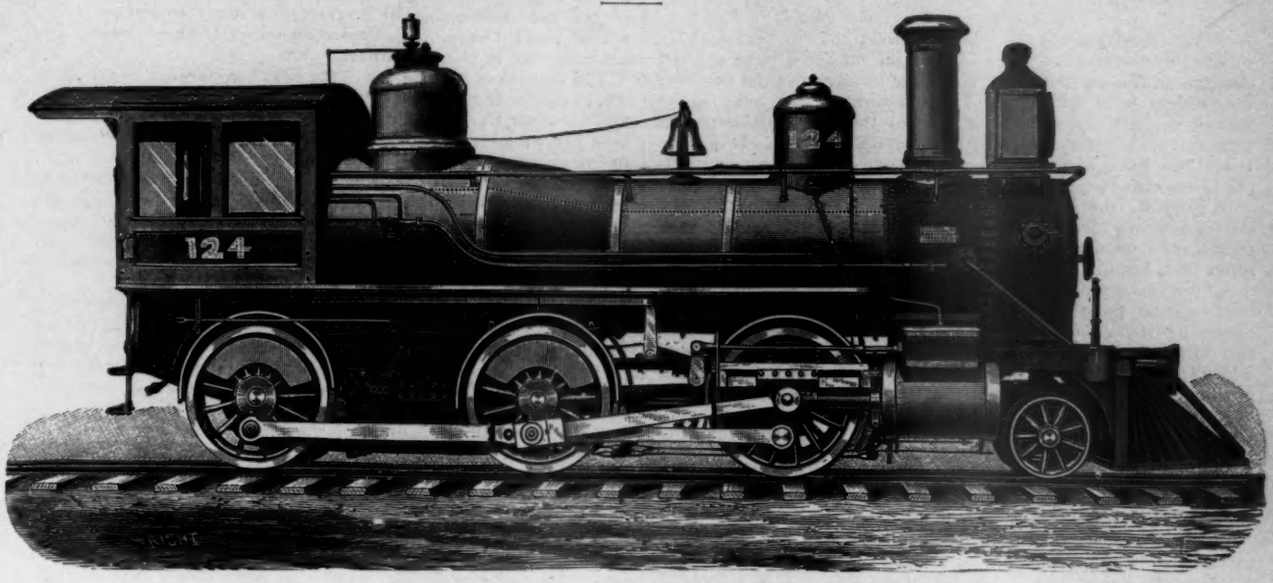


EIGHT-WHEEL "AMERICAN" LOCOMOTIVE

BY THE GRANT LOCOMOTIVE WORKS, PATERSON, N. J.

Total weight in working order	100,000 lbs.
Total weight on driving-wheels	64,100 "
Diameter of driving-wheels	5 ft. 2 in.
Diameter of truck-wheels	2 " 6 "
Diameter of main driving-axle journal	7½ "
Distance from center of front to center of back driving-wheels	8 ft. 6 "
Total wheel-base of engine	23 " 3 "
Total wheel-base of engine and tender	45 " 7½ "
Diameter of cylinders	18 "
Stroke of cylinders	24 "
Outside diameter of smallest boiler ring	54 "
Length of fire-box, inside	6 ft. 0 in.
Width of fire-box, inside	2 " 10 5/16 "
Depth of fire-box, crown-sheet to top of grate	5 " 6 "
Number of tubes	227
Outside diameter of tubes	2 in.
Length of tubes	11 ft. 11 "
Grate surface	17 sq. ft.
Heating surface, fire-box	123 " "
Heating surface, tubes	1,343 " "
Heating surface, total	1,466 " "
Exhaust nozzles	Double.
Width of steam-ports	1¼ in.
Width of exhaust-ports	2½ "
Throw of eccentrics	5¼ "
Greatest travel of valve	5¾ "
Outside lap of valve	1 "
Smallest inside diameter of chimney	1 ft. 6 "
Height, top of rail to top of chimney	15 " 0 "
Height, top of rail to center of boiler	6 " 7½ "
Water capacity of tender tank	3,600 gals.

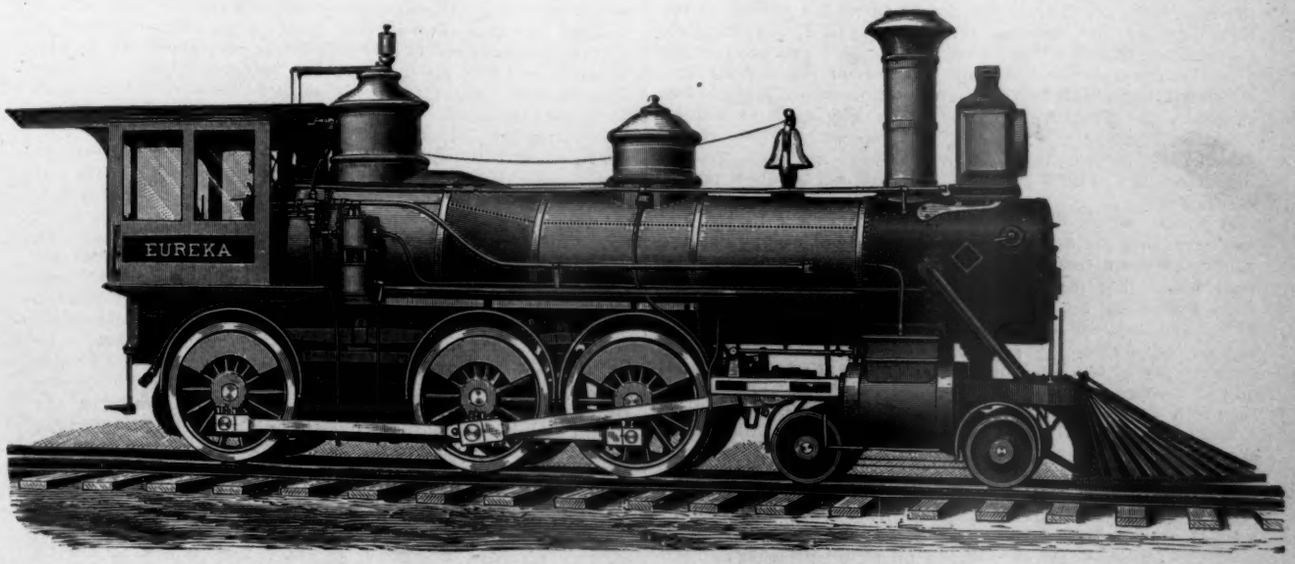
CATECHISM OF THE LOCOMOTIVE.



MOGUL FREIGHT LOCOMOTIVE.

BY THE HINKLEY LOCOMOTIVE COMPANY, BOSTON, MASS.

Total weight in working order	104,000	lbs.	Length of fire-box, inside	6 ft.	0	in.	Exhaust nozzles	Single.
Total weight on driving-wheels	90,000	"	Width of fire-box, inside	2 "	11	"	Size of steam-ports	18X7¼ in.
Diameter of driving-wheels	4 ft.	4½ in.	Depth of fire-box, crown-sheet to top of grate	5 "	8	"	Size of exhaust-ports	18X3 "
Diameter of truck-wheels	2 "	6 "	Number of tubes			218	Throw of eccentrics	5 "
Diameter of main driving-axle journal.		7½ "	Outside diameter of tubes			2 in.	Greatest travel of valve	5½ "
Distance from center of front to center of back driving-wheels	15 ft.	9 "	Length of tubes	11 ft.		6 "	Outside lap of valve	0¾ "
Total wheel-base of engine	23 "	4 "	Grate surface	17.5		sq. ft.	Smallest inside diameter of chimney	1 ft. 3 "
Total wheel-base of engine and tender	46 "	5¾ "	Heating surface, fire-box	125		" "	Height, top of rail to top of chimney	14 " 0 "
Diameter of cylinders		19 "	Heating surface, tubes	1,230		" "	Height, top of rail to center of boiler	6 " 5 "
Stroke of cylinders		24 "	Heating surface, total	1,355		" "	Water capacity of tender tank	3,000 gals.
Outside diameter of smallest boiler ring		53⅜ "						



TEN-WHEEL FREIGHT LOCOMOTIVE

BY THE GRANT LOCOMOTIVE WORKS, PATERSON, N. J.

Total weight in working order	90,000	lbs.	Length of fire-box, inside	6 ft.	0	in.	Exhaust nozzles	Double.
Total weight on driving-wheels	66,000	"	Width of fire-box, inside	2 "	10½	"	Width of steam-ports	1¾ in.
Diameter of driving-wheels	4 ft.	6 in.	Depth of fire-box, crown-sheet to top of grate	5 "	2¾	"	Width of exhaust-ports	2½ "
Diameter of truck-wheels	2 "	2 "	Number of tubes			204	Throw of eccentrics	5½ "
Diameter of main driving-axle journal.		7½ "	Outside diameter of tubes		2	in.	Greatest travel of valve	5½ "
Distance from center of front to center of back driving-wheels	13 ft.	6 "	Length of tubes	13 ft.	2¾	"	Outside lap of valve	0¾ "
Total wheel-base of engine	24 "	6⅜ "	Grate surface	17		sq. ft.	Smallest inside diameter of chimney	1 ft. 6 "
Total wheel-base of engine and tender	44 "	10¾ "	Heating surface, fire-box	123		" "	Height, top of rail to top of chimney	14 " 4⅜ "
Diameter of cylinders		18 "	Heating surface, tubes	1,359		" "	Height, top of rail to center of boiler	6 " 1¼ "
Stroke of cylinders		24 "	Heating surface, total	1,482		" "	Water capacity of tender tank	3,000 gals.
Outside diameter of smallest boiler ring		52 "						

the handle of the engineer's valve is placed in the II, or running position, and should be about 20 to 25 lbs. As the pressure in the train-pipe should be 70 lbs., that in the main reservoir should be 90 lbs.

QUESTION 691. *In making up trains what should be done?*

Answer. All the hose couplings between the different vehicles should be connected together so that the brakes will be applied throughout the whole train. No brake in any car must be "cut out" unless it is defective. The coupling of the hose at the rear of the last car and at the front of the engine (if there is a hose there) should be attached to the coupling-hook. If for any reason the hose between two vehicles are not used for connecting the brakes they should be attached to their coupling-hooks.

In coupling the hose, place the coupling shoulders, near the stop-pin, firmly together, then twist the heads into place as if they turned on a pivot, firmly pressing the heads toward each other until both heads strike the stop-pins.

All the brake-pipe cocks, 29′ 29″, Plate VI, should be opened by turning their handles *down or at right angles to the brake-pipe*,* excepting that of the cock at the rear end of the train, which should be closed by turning its handle so as to stand parallel with the train-pipe. If the brake-pipe is extended to the front of the engine, the cock at the front end of the train should also be closed. The hose at the front (if there is one at the front) and rear ends of the train should be attached to their coupling-hooks.

The handles *K*, fig. 369, of the four-way cock on the triple-valve of the old brake, and the handles of the cocks under the auxiliary reservoirs should also be turned horizontal.

The new or quick-acting triple-valve has no four-way cock attached to it, but has a stop-cock, *A*, fig. 401, on the pipe which connects the triple-valve with the brake-pipe. This stop-cock should be opened by turning its handle *B* so as to point upward, as shown in fig. 401. When the cock is closed the handle stands horizontal. This same arrangement is used on the new freight car brakes.

It is very important to the successful action of the brake, and to avoid detentions, that the handles of the cocks should be placed in their proper position before starting.

QUESTION 692. *How should the brakes be inspected before starting?*

Answer. Before leaving terminal stations, or wherever there has been any change in the make-up of the train, after all the couplings are made, the engineer should turn the handle of the engineer's valve 9, Plate VI, to the release or charging position (see figs. 371 and 375), and charge the auxiliary reservoirs with air of not exceeding 70 lbs. pressure per square inch. After the reservoirs are charged he should bring the handle to the right, just over the running notch, but not far enough to allow air to escape from the brake-pipe; leaving it in this position for a few moments and observing whether there is any leakage, which will be indicated by a gradual falling off in pressure, as shown by the air-gauge. If there is a leakage it should be found and the defect remedied. The pipes and joints of the brakes must be kept tight, and when leaks are discovered, if the defect is a serious one, the car should not be used until it is repaired.

A person whose duty it shall be to inspect the brakes and *know* that they are in proper order, should then see that all the hand-brakes are released, and then ask the engineer to apply the brakes. The inspector should then walk to the rear of the train, examining the brakes of each car, and see whether they have been applied. If he finds them set all right, he should signal "off brakes" from the rear of the train. The engineer should reply by two light blasts of the whistle or other signal and immediately release the brakes. The inspector should then return to the engine and notice whether the brakes are released on every car. If any are found which are still set, he should release them by turning the handle of the four-way cock *K*, fig. 369, of passenger cars down. When the brakes are released, the handles of the cocks should be turned back to their first position, and the inspector should observe whether there is the full air pressure — 70 lbs.—in the main reservoir. If not, it should be pumped up to full pressure and the brakes applied again by the engineer. If those which were not released on the first test "stick" again, they should first be released by "bleeding" and then cut out. If all the other brakes are released, the brakeman will report all right; if any of them are not released, they should be cut out if they do not release on the second trial.

It should be understood that if cars which have different air pressures in the brake-pipes and auxiliary reservoirs are coupled together, air from the brake-pipe having the higher pressure escapes into the pipe having the lower pressure, and thus applies the brakes on the car which has the greatest pressure. In such cases by "bleeding" the cars, with over-pressure, until the brakes commence to release, the time required to equalize the pressure by pumping on the engine will be saved.

The valves for the application of the brakes from the inside of the car should also be examined when the brakes are inspected, and it should be observed whether all their connections are tight and in good condition.

The discovery of a defect in the brake apparatus affecting its working, either before or during a trip, should at once be made known to all trainmen and to the engineer, so that there may be a proper understanding of it, and measures should be taken to insure safety in running the train.

After making up or adding to a train, or after a change of engines, the rear brakeman should ascertain whether the brake is connected throughout the train. The engineer must, under these circumstances, always test the brakes, to insure their being properly coupled and in order for use.

QUESTION 693. *How should the air pump be worked?*

Answer. While the locomotive is in service it should be run constantly, but not faster than is necessary to maintain the required air pressure in the reservoirs. The pump governor being connected to the train-pipe should constantly be used and should be set to maintain a pressure of 70 lbs. therein, as shown by the air-pressure gauge.

While running the handle of the engineer's valve should be kept in the II, or running position, fig. 371. This allows the brake-pipe and auxiliary reservoirs to be charged with air and an excess of pressure to be accumulated in the main reservoir.

QUESTION 694. *How should the brakes be applied to make ordinary stops?*

Answer. The brakes, as has been explained, are applied when the pressure in the brake-pipe is suddenly reduced, and released when the pressure is restored.

It is of very great importance that every engineer should bear in mind that the air pressure may sometimes reduce slowly, owing to the steam pressure getting low, or from the stopping of the pump, or from a leakage in some of the pipes when one or more cars are detached for switching purposes, and that in consequence it has been found absolutely necessary to provide each cylinder with what is called a leakage groove, which permits a slight pressure to escape without moving the piston, thus preventing the application of the brakes when the pressure is slowly reduced, as would result from any of the above causes.

This provision against the accidental application of the brakes must be taken into consideration, or else it will sometimes happen that all of the brakes will not be applied when such is the intention, simply because the air has been discharged so slowly from the brake-pipe that it only represents a considerable leakage, and thus allows the air under some cars to be wasted.

It is thus very essential to discharge enough air in the first instance, and with sufficient rapidity, to cause all of the leakage grooves to be closed, which will remain closed until the brakes have been released. In no case should the reduction in the brake-pipe for closing the leakage grooves be less than 4 or 5 lbs., which will move all pistons out so that the brake-shoes will be only slightly bearing against the wheels. After this first reduction the pressure can be reduced to suit the circumstances.

On the other hand, locomotive runners should be careful not to use too much force in making ordinary stops. By applying the brakes at a fair distance from the station, with moderate force, the train may be stopped gently and without inconvenience to the passengers, while if the brakes are put on with too much force, the train is jerked in a manner that is extremely disagreeable, and may be dangerous to the passengers. To avoid this in making a stop, the handle of the engineer's valve should not be turned beyond the IV position; "for service stops," see fig. 371. With a train of two or three cars the handle should be kept in that position for a few seconds only and should then be closed gently by moving the handle to the III position, when the pressure in the brake-pipe has been reduced from 4 to 8 lbs. as indicated by the gauge. The brakes are fully applied when the pressure in the brake-pipe, as shown by the gauge, has been reduced about 20 lbs. *Any further reduction is a waste of air.* The brakes should be applied far enough away from the station so that the train may be controlled and stopped without moving the handle beyond the IV position. As the brakes on the train are applied from the auxiliary reservoirs, frequent use of the brakes reduces the pressure, and consequently the power of the brakes; for while applying the brakes the supply of air to the reservoirs through the brake-pipe is cut off. Therefore, after each application the handle of the engineer's valve should be turned to the extreme left until the maximum pressure is obtained, after which it should be moved to the II position, where it should remain while running. It is bad practice to apply and release the brakes more than once or twice at the most in service stops, unless time is given between application for recharging

* On the old brake the plugs of these cocks are horizontal, on the new quick-acting brake they stand vertical.

the train reservoirs, as it reduces the pressure too much on the train.

The most satisfactory stops are made by applying the brakes, lightly at first, at sufficient distance away, and increasing the pressure as the train draws nearer the station until it is almost stopped; then, excepting on heavy grades, releasing the brake, by turning the handle to the I position, to avoid jerking the train. After the air has been released from the brake-pipe of long trains, by placing the handle of the brake-valve in the IV, or "service stop" position, and is then moved back to the III, or "closed" position, air will continue to escape through the valve, as explained in answer to question 647, until the pressure has been reduced uniformly throughout the brake-pipe by an amount indicated by the black pointer of the gauge. This is the equalizing feature of this valve which is of great importance in the operation of the brakes, especially on long trains.

A reduction of pressure in train-pipe of about

7	lbs.	will	give	about	4	lbs.	per	sq.	in.	in brake-cylinder.
9	"	"	"	"	19	"	"	"	"	"
11	"	"	"	"	26	"	"	"	"	"
13	"	"	"	"	40	"	"	"	"	"
15	"	"	"	"	46	"	"	"	"	"
17	"	"	"	"	50	"	"	"	"	"

QUESTION 695. *How should the air-brake be used in case of danger?*

Answer. In case of danger the object, of course, is to stop as quickly as possible without reference to the comfort of any one. In such cases the handle of the engineer's valve should be turned to the V, or "emergency position." Stops should not be made in this way any oftener than is necessary, as they are liable to slide and flatten wheels of the train.

QUESTION 696. *What must be done to release the brakes?*

Answer. The handle of the engineer's valve must be turned to the extreme left, or to the I, or "release position," quite against the stop, and should be kept there for about 10 seconds and then moved back to the II position against the intermediate stop, which is the feed position, and is where it should remain while the train is running. This course is necessary so as to be always ready with an excess of pressure in the main reservoir to release the brakes and avoid the necessity of "bleeding" to release them. The handle should never be left midway between these two positions, as this will nearly, if not quite, close the passage leading to the brake-pipe.

If the air-gauge, while running, shows too much excess of pressure, the excess pressure-valve 21, fig. 373, may have become obstructed. After coming to a full stop at a station, move the valve-handle to the "emergency position," V, and accumulate a high pressure in the main reservoir; then move the handle back from the "emergency position," V, to the "running position," II, so that the full reservoir pressure is brought upon the excess pressure-valve, to blow out any obstruction. If the difficulty is thus removed, the black hand of the gauge should move up to within 20 lbs. of the red one; if it does not, the valve should be examined and cleaned.

Where two or more engines are coupled in the same train the cock 8, fig. B, Plate VI, should be closed upon all but the head engine of the train, in order to permit this engine to handle the train brakes without interference from the other engines.

Engineers of all trains should avoid making exhibition stops, and should never, excepting on a heavy grade, or in case of necessity, hold the brakes fully applied until the train comes to a full stop, as this causes a reaction in the motion of the train which is very disagreeable to passengers, and in case of a long freight or stock train, is damaging when there is much slack in the couplings. This can be avoided ordinarily, on passenger trains, as already explained, by releasing the brakes gradually before coming to a full stop, so that all the air will be off at the moment the stop is made.

On a long train, if the engineer's brake-valve be opened suddenly and then quickly closed, the pressure in the brake-pipe, as indicated by the gauge, will be suddenly and considerably reduced on the engine, and will then be increased by the air pressure coming from the rear of the train; hence it is important to always close the engineer's brake-valve slowly and in such a manner that the pressure, as indicated by the gauge, will not be increased, or else the brakes on the engine and tender, and sometimes on the first one or two cars, will come off when they should remain on.

On long down grades it is important to be able to control the speed of the train, and at the same time to maintain good working pressure. This is easily accomplished by running the pump at a good speed, so that the main reservoir will accumulate a high pressure while the brakes are on. When, after using the brakes some time, the pressure has been reduced to 60 lbs., the train-pipes and reservoirs should be recharged as much as possible before the speed has increased to the maximum allowed. A greater time for recharging is obtained by considerably reducing the speed of the train just before recharging and by taking advantage of the variation of the grades.

To release the brakes with certainty, it is important to have a higher pressure in the main reservoir than in the main pipe. If the engineer feels that some of the brakes are not off, it is best to turn the handle of the engineer's brake-valve just far enough to shut off the main reservoir, and then pump up 15 or 20 lbs. extra, which will help to release the brakes, all of which can be done while the train is in motion.

QUESTION 697. *If, while the train is moving, the brakes are applied from some cause unknown to the engineer, what should he do?*

Answer. Whenever the brakes are applied from any cause, it is important to maintain an excess of pressure in the main reservoir, in order to be able to release them promptly thereafter. If there is but a slight reduction of pressure in the train-pipes, indicating that the brakes have been applied by leakage, he should at once move the handle of the brake-valve to the I position in order to release them; but if the brakes should be applied at once and the air-gauge show that all the air in the train-pipe has escaped, he will know that a pipe or hose has burst, a coupling has been broken, or that a conductor's valve has been opened, and he should aid in stopping the train by turning the handle to the V, or "emergency position," to stop as quickly as possible, and also to prevent the escape of air from the main reservoir. When the train is stopped he can release the brakes and await the signal from the conductor to proceed. If the brakes are not released by turning the handle to the I, or "release" position, it should be put on the III, or "closed" position, until the pressure in the main reservoir has been increased 10 or 15 lbs., and the handle should then be turned to the I, or "release" position. If this does not accomplish the desired end, the brakes should first be applied quickly and then released. If the engineer is not able to release the brakes, he should signal the fact to the trainmen, who will then assist in releasing them by "bleeding."

QUESTION 698. *How are the brakes applied from the inside of the cars?*

Answer. This can be done in three different ways: *First*, by opening the conductor's valve, by pulling on its cord and *holding it down* until the train is stopped. The new form of conductor's valve has no spring, and is open when the handle is up, and will remain so without holding it. *Second*, by disconnecting the hose couplings. *Third*, by opening the cock 29", Plate VI, on the brake-pipe on the rear end of the train. These methods should be used only in cases of emergency.

QUESTION 699 *In running trains up or down steep grades exceeding 100 ft. per mile and a half mile in length what should be observed?*

Answer. The engineer should assure himself that the brake apparatus is in good working condition. Before going down such grades he should examine the valve-gear carefully, to see that it will be efficient if the engine is reversed.

QUESTION 700. *Why is the train-pipe carried to the front end of the locomotive?*

Answer. This is done so that the brakes on the locomotive can be coupled together, in case two locomotives are used on the front of the same train—called a "double-header"—or so that the brakes of the locomotive can be coupled to the cars, in case it is used as a pusher at the rear end of a train.

QUESTION 701. *How are the air-brakes operated on a "double-header," or when two engines are coupled together?*

Answer. When two or more engines equipped with air-brakes are coupled to a train, *the forward engine should control the air brake*, but all the engines should be connected to the brake-pipe. When the train is in motion, the stop-cock 8, fig. B, Plate VI, should be closed upon all but the leading engine, and the leading engineer should do all the braking. Otherwise the brakes may all be pumped off, by the rear engineer, very soon after the brakes are applied by the first engineer, and this will render the brakes useless. Hence the leading engine must control the train brakes entirely and absolutely, except in case of accident to the air of leading engine, and until a proper signal is given by the first engineer for the second engineer to assume control of the air-brakes on train, for which contingency the second engineer must at every moment be *prepared to act instantly on a mountain grade.*

If from any cause the supply of air or any part of the brake on the leading engine has failed, and it is desired to give up the control of the brakes to the second engineer, a signal (usually two short and one long blast of the whistle – – ———) should be given by the first engineer, and the second one by repeating it should signify that he understands it and has control of the air-brakes. The second engineer having assumed control of the brakes, should retain entire charge of them to the end of the trip, unless it may be necessary to again put them in charge of

the first one. On heavy grades the aim of the engineer should always be *to keep control of the train. Descending at high speed must not be practiced with any train,* for there may come a time when some part of the machinery may fail, and *while it may be practicable to control speed by hand-brakes at* 8 *to* 10 *miles per hour, it may be impossible at* 20 *to* 30 *miles per hour to regain its control.**

The driver-brakes should not be used too freely on mountain grades, as it heats the tires of driving-wheels, expands and loosens them on the wheel centers, which may not only destroy their brake efficiency, but may make the engine useless for draft purposes also.

QUESTION 702. *How can the brakes be released if they are applied on a car which is not coupled to an engine, or if from other cause they cannot be released by the locomotive runner?*

Answer. On passenger cars this is done by turning down the handle of the release cock, 20, Plate VI—below the auxiliary reservoir—which opens it and allows the air in the reservoir to escape; which—in railroad parlance—"bleeds" the reservoir and the brake-cylinder.

QUESTION 703. *How can the brakes be released when they have been applied by a burst hose?*

Answer. By closing the brake-pipe cock directly in front of the burst hose; the brakes ahead of it can then be released by the locomotive runner, and those behind it, as has been described in answer to the previous question.

QUESTION 704. *What is meant by "cutting out" the brakes on a car?*

Answer. It means that the compressed air in the brake-pipe is shut off from the triple-valve, auxiliary reservoir, and brake-cylinder, so that they do not operate, but the air can still pass through the brake-pipe to the cars behind.

QUESTION 705. *How can the brakes on a car be cut out?*

Answer. With the old form of automatic brake the handle *K*, fig. 369, of the four-way cock attached to the triple-valve should be turned down to the half-way position II, fig. *A*, Plate VI, and the release cock 20″, below the auxiliary reservoir, should be opened, so as to release the brakes on the car if they are on.

QUESTION 706. *What must be done if a car or the engine is detached from the train?*

Answer. When any of the vehicles in a train must be uncoupled, trainmen should not close the brake-pipe cocks, by turning their handles at right angles to the brake pipe, or disconnect the hose until the brakes have first been released by the engineer. Before engines or cars are uncoupled, the brakes should be fully released on the whole train. Neglecting this precaution, or setting the brakes by opening a valve or cock when the engine is detached, may cause serious inconvenience in switching.

The cocks 29′ 29″, Plate VI, on each side of the hose couplings to be separated should then be closed—by turning their handles at right angles to the brake-pipe—to prevent the application of the brakes on the cars which are uncoupled. The hose couplings should then be disconnected. *This must always be done by hand,* and the couplings should then be hung on their coupling-hooks.

QUESTION 707. *What is essential in taking care of the brake-cylinders and other parts of the brakes?*

Answer. The brake-cylinders must always be kept clean and free from gum, so that they will readily release when the air has been discharged, and should be oiled once in three months with suitable oil furnished for that purpose. The last date of oiling should be marked on the cylinders with chalk. The pistons should be taken out once a year and cleaned, at which time the brake rigging should have a general overhauling and be tested. The date of this general overhauling and testing should be stencilled in white lead on the cylinder.

All parts of the brakes should be kept clean and in good condition, and the pipe connections tight.

QUESTION 708. *How should the air-pumps be taken care of?*

Answer. The steam-cylinder should be lubricated with a small quantity of engine oil, and the air-cylinder should be sparingly lubricated with a small quantity of 32° gravity West Virginia mineral oil (tallow or lard oil should not be used in the air-cylinder).

In case the air-pump gets hot in operation on the road, use a small amount of valve oil, *not tallow,* to overcome the difficulty temporarily. Head-light oils will cut the gum out, but except it is very thoroughly cleaned out will cause heating worse than before, and is bad oil to use on this account.

The best means for cleaning out the air-pump thoroughly, and it should be done at the shops, is to disconnect the discharge pipe and pump through a few quarts of weak lye, discharging it into a proper vessel and pumping it through again until all passages are thoroughly cleaned. After the lye use clean warm water, to thoroughly clean out all the passages, then remove the lower head, shove the piston to the upper head, and oil the cylinder bore with oily waste.

QUESTION 709. *How should the triple-valves be taken care of?*

Answer. In cold or damp weather they should be drained frequently to let out any water that may have collected. This can be done by slacking the nut or the plug in the bottom of the triple-valve, and thus letting the water escape; the plug should then be screwed up again. The water in the drain-cup on the tender should be drained out daily in cold or damp weather by the cock under it. The valves for the application of the brakes from the inside of the car should be kept tight.

QUESTION 710. *What should be observed with reference to the main reservoir?*

Answer. The water should be drained out of it ordinarily once a week, and in winter or damp weather daily. If the pump is not kept well packed considerable water will accumulate in the main reservoir.

QUESTION 711. *What should be done in case a train breaks in two?*

Answer. In case a train breaks in two the *brakeman should close the stop-cock on the rear car* of the part of the train remaining attached to the engine, when he reaches it, and then give the engineer a signal to let the brakes off.

When cars are again properly coupled up, *before opening the air into the rear end of the train,* the brakeman should give the engineer a signal to set the brakes, which should be done strong, and be left on until the brakeman opens the air-cocks into rear section of the train. When this is done the engineer will have regained control of the air in the entire train as before the break in two.

This action will save valuable time, which otherwise may be spent in releasing the air on each car by hand.

QUESTION 712. *What should be done in case hose couplings are frozen, so that they cannot be uncoupled, or leak?*

Answer. They should be thawed with a lighted torch, care being taken so as not to heat them so hot as to injure the packing or rubber of which the hose is made.

QUESTION 713. *How does the Automatic Freight Train Brake operate?*

Answer. The construction and operation of the freight train brake is substantially the same as that of the passenger train brake. The parts of the freight brake are, however, lighter and are arranged more compactly. They are shown in figs. 387–392.

QUESTION 714. *When and how is the pressure-retaining valve used on freight cars?*

Answer. As explained in answer to question 665. In going down long grades it becomes necessary for the engineer to recharge the reservoirs with air, and to do so he is obliged to release the brakes. When the handle of the pressure-retaining valve 40, fig. 387, which is located at the end of the car near the brake-wheel, is turned horizontal, an air pressure of 15 lbs. is retained in the brake-cylinder after the brake is released by the engineer. When the valve-handle points down, the valve allows the air to exhaust freely from the brake-cylinder when the brakes are released.

The retaining feature of this valve should only be used on long grades; at all other times the valve-handles should be turned to point down.

QUESTION 715. *What precaution should be taken in cases when only a part of the cars, or the engine and tender only are equipped with air-brakes?*

Answer. After shutting off steam from the engine, engineers should allow the slack of the train to close in against the engine before applying the brakes. This, to a great extent, will prevent concussions of cars against each other in the rear portion of the train, which are not provided with air-brakes.

(TO BE CONTINUED.)

* From the Code of Rules Governing Engineers and other Employés in use of Westinghouse Air-Brakes on the Northern Pacific Railroad.

Manufactures.

Cars.

THE United States Rolling Stock Company has taken a contract for 1,000 freight cars for the Central Railroad of Georgia, which will be built at its shops at Anniston, Ala. The Company has also a contract for 200 freight cars for the Savannah, Florida & Western road.

THE Raleigh & Gaston Railroad Company is building three new passenger cars in its shops in Raleigh, N. C.

The "Continuous" Rail-joint.

THE accompanying illustrations show a new rail-joint which is now being introduced after careful preliminary trials.

This joint is made up of two parts: one the splice-bars, which are used to maintain line, and the other the clamp, which is provided to maintain surface.

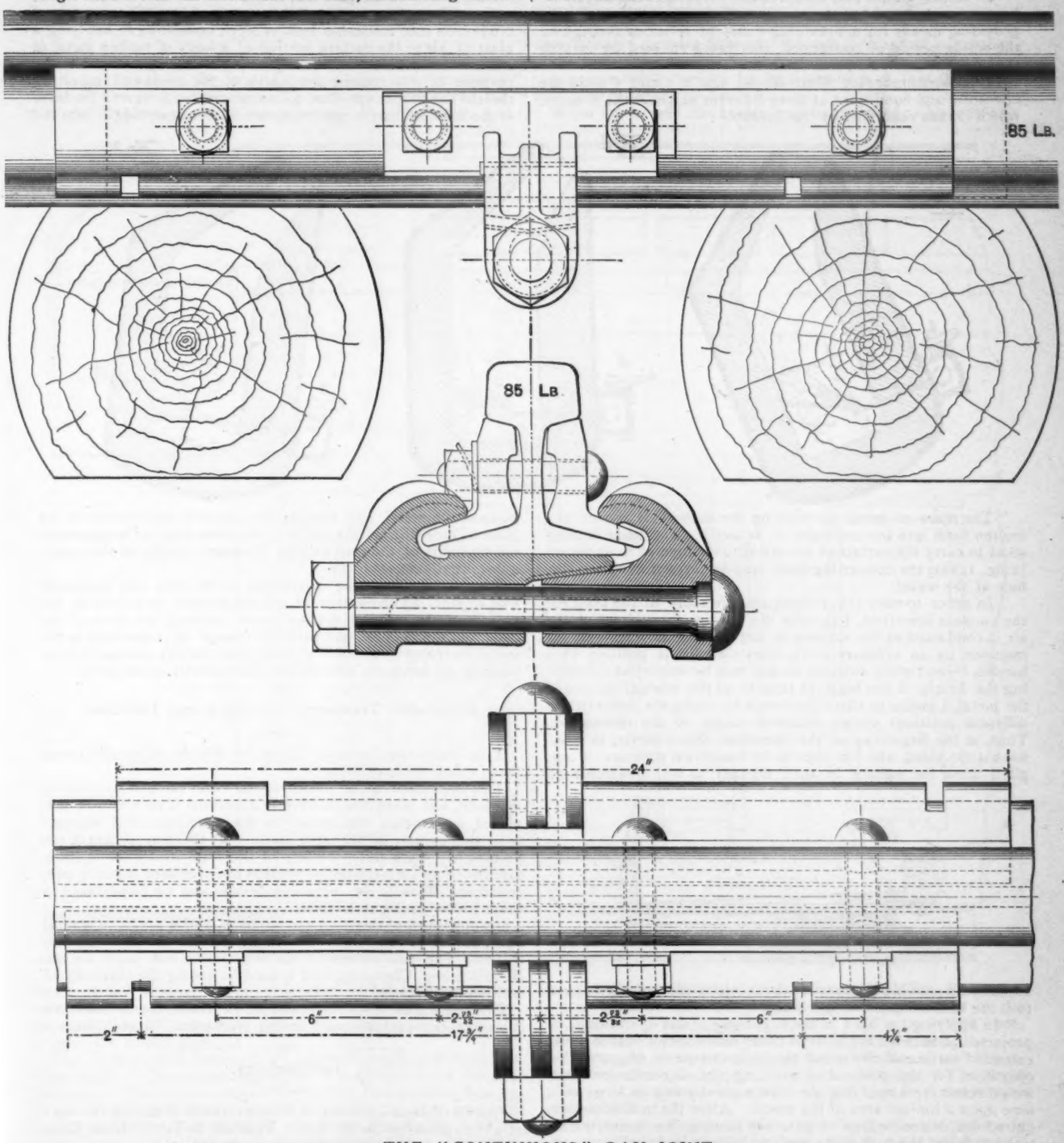
The splice-bars used have their bearing in the usual way, between the under side of the head of the rail and the top side of the rail base, but with the outer edges of the bars formed so as to reach beyond the base of the rail, but not to bear upon or touch the supporting ties.

The clamping device is so constructed that it engages the angle-bars within the line of the rail base, maintaining the two connecting rails rigidly together in the same plane or surface, allowing no vertical motion. These two devices co-acting ensure an even wear of rail from end to end. This makes the device a self-contained and structural one; making the joint as nearly equivalent as possible to the unbroken rail. The conditions for the support of it are only those demanded for the main body of the rail.

The bars are slotted so as to allow of the usual spiking to prevent the creep of rails, except that the spikes have a bearing against the edge of the rail.

Experimental sections of track laid with this joint have been in use on five or six railroads for from 12 to 18 months. On one piece of track they have withstood a service of over 20,000,000 tons passing over them, the daily average being 1,740 cars; and in that time the joint ties required but one surfacing and the nuts but one going over to tighten.

This joint, it is claimed, will correct the uneven wear at the ends of the rails, if not battered. It is also claimed that the joint is no longer an experiment, but that its utility has been demonstrated.



THE "CONTINUOUS" RAIL-JOINT.

The manufacturers make the following claims for it:

1. Strength of joint equal to that of the body of the rail.
2. Increased endurance of rail.
3. Economy in maintenance of joints and ties thereunder.
4. Smoothness of track, ensuring easy and quiet riding.
5. Reduction in first cost over all six bolt splices.

All of these claims are made after trials extending over a period of 18 months, as noted above.

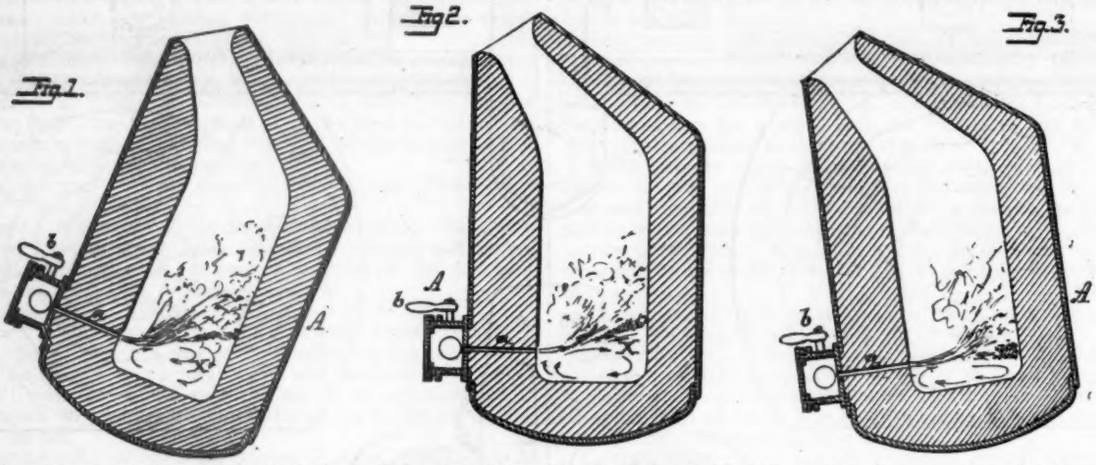
The "continuous" rail-joint is manufactured by the McConway & Torley Company, of Pittsburgh, Pa.

The Robert Steel Process.

In view of the interest felt in new processes in the manufacture of steel, we give herewith the illustrations and the greater part of the specifications of patent No. 400,010, dated March 19, 1889, and granted to Gustave L. Robert, of Stenay, France (Assignor to John W. Bookwalter, of Springfield, O.), for a "process of converting crude iron into malleable iron or steel."

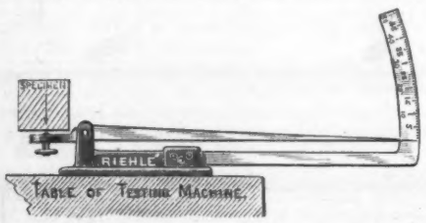
Mr. Robert claims that his invention overcomes the defects inherent in the rapid mode of conversion of iron into steel, by providing means for maintaining constant relations throughout the whole period of conversion, this being effected by varying the position and volume of the blast.

In the accompanying illustrations, figs. 1, 2 and 3 show the operation and conditions at three different stages in the process, which is thus described by the Inventor:



"The mass of metal constituting the bath X is passed in a molten form into the converter A, as usual. The latter is tilted so as to carry the surface of the metal to the tuyeres a, as shown in fig. 1, that the converting-blast may be thrown upon the surface of the metal.

"In order to vary the volume and pressure of the blast for the purpose described, I throttle the passage through which the air is conducted to the tuyeres in any suitable manner—as, for instance, by an ordinary valve controlled in its position by a handle, b—and while different means may be employed for varying the height of the blast in respect to the normal surface of the metal, I prefer to effect this result by tilting the converter to different positions during different stages of the operations. Thus, at the beginning of the operation, the converter is tilted so that the blast, which is then at its maximum pressure, is applied upon the surface in such manner as will overcome as



speedily as possible the inertia of the metal and quickly impart to it the desired speed of gyration.

"In applying the blast in the beginning of the operation it is projected at such an angle as to come into contact with a more extended surface of the metal than at subsequent stages of the operation for the purpose of avoiding the overoxidation that would result from applying the blast violently and in large volume upon a limited area of the metal. After the metal has acquired the desired speed of gyratory motion, the converter is tilted to lower the bath to its position (shown in fig. 2), so as to act upon a more limited area of the metal at one time, but with a greater atomizing or dividing effect, bringing the particles of iron into more intimate contact with the air and increasing the combustion and heat and the fluidity of the metal, and with this change in the position of the blast I begin to reduce the volume and the pressure, proportioning such reduction to the effect desired to be produced, as may be determined by indications easily recognized by any one skilled in the operation of conversion. As the process continues, the converter is further tilted toward the position shown in fig. 3, and from this on the pressure and position of the blast are so varied or maintained as may be necessary to secure the desired result.

"By the operation above described, I can readily avoid the tendency to overoxidation that results at the beginning of the rapid process of conversion from the inertia of the metal, the sluggishness of its movements, and from the difficulty of imparting to it the desired speed of gyration by a blast applied locally at the surface, without also supplying an excess of the oxidizing agent."

The claims in the patent specifications are as follows:

"1. The within-described improvement in the conversion of crude iron into malleable iron or steel, consisting in applying a blast of air to the surface portion of a body of molten metal at a maximum pressure at the beginning of the operation for the purpose of overcoming the inertia of the metal and imparting thereto the proper speed of gyratory motion, lowering the level of the blast as the process continues without carrying it into the body of the metal, and varying the pressure and volume of the blast to meet the requirements of the reduction in the combustible elements of the iron and the increased fluidity of the metal, substantially as set forth.

"2. In the process of converting crude iron into malleable iron or steel by the action of a blast applied locally upon the surface of the mass of molten metal, varying the level of the blast and the volume and pressure thereof in proportion as the metal increases in speed of gyration and fluidity and as the combustible elements are eliminated, substantially as set forth."

Adjustable Transverse Elastic Limit Indicator.

The illustration herewith shows the Riehle adjustable transverse elastic limit indicator.

This apparatus can be placed on the lower table of any testing machine, and when the transverse specimen is in position it is placed underneath the center of the specimen, and adjusted with the pointer on the zero mark. As the test proceeds the pointer will pass over the face of the scale, and show in thousandths of an inch the deflection that the specimen is being subjected to. This is an ingenious device, and its importance to those investigating these things is apparent.

An apparatus of this kind can be made, and is made, in several sizes, suited to the larger machines, and for the smallest machines. The one shown in the illustration was made for the Dennis Long Company, and is used in testing the elasticity of cast-iron specimens.

This apparatus is made by Riehle Brothers, the well-known manufacturers of scales and testing machines, Philadelphia.

Locomotives.

The Pittsburgh Locomotive Works recently completed several freight engines for the St. Louis, Vandalia & Terre Haute Railroad, and have a number of orders on hand.

The Baldwin Locomotive Works, Philadelphia, recently delivered three passenger engines to the Raleigh & Augusta Air Line. Late orders include 10 passenger engines for the Philadelphia & Reading Railroad.

The Rogers Locomotive Works, Paterson, N. J., are building a number of consolidation engines for the Louisville & Nashville road.

The Schenectady Locomotive Works, Schenectady, N. Y., are building three passenger engines, with 18 by 24 in. cylinders,

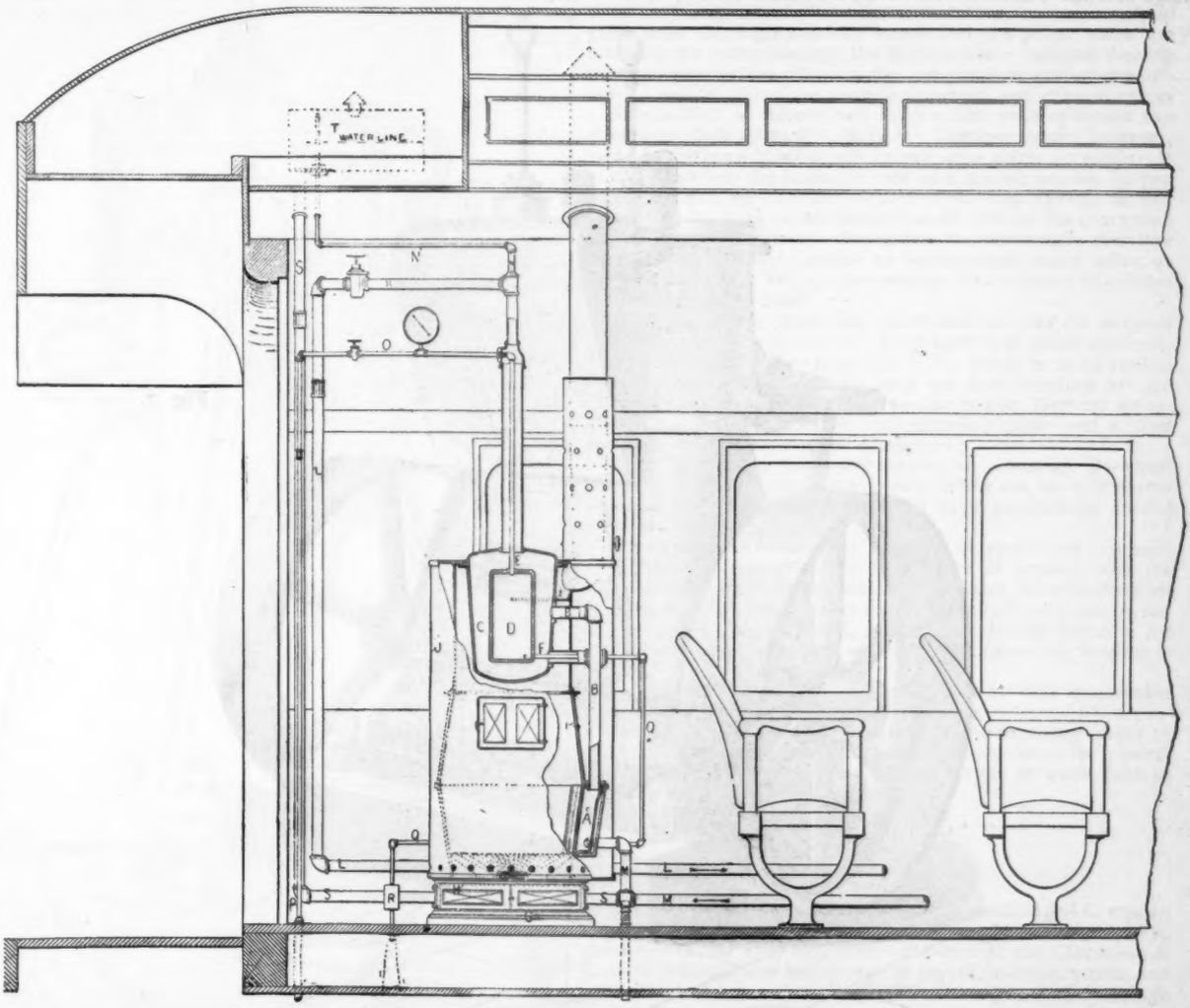
15 mogul freight engines, and seven six-wheel switching engines, for the Lake Shore & Michigan Southern road.

THE Brooks Locomotive Works, Dunkirk, N. Y., are building six engines for the Kansas City & Southern road.

THE Rhode Island Locomotive Works, Providence, recently delivered 10 locomotives to the Savannah, Florida & Western; five to the Charleston & Savannah, and seven to the Brunswick & Western.

The Non-Pressure Car Heater.

THE accompanying illustration shows the construction and general arrangement in the car of a heater, which has been tested for some time in general use and is now being introduced for this special purpose. It belongs to the class in which hot water is the heating agent; this water circulates through the coils, receiving its heat in the first place ordinarily from steam brought from the locomotive, but in case of necessity from a fire built in the heater itself.



The form of this heater, both internally and externally, is very simple. The steam supply pipe *E* is carried down through the vertical flow-pipe, on top of the heater, into a steam-heating drum, *D*, which is provided with a waste-pipe, *F*, to carry off any condensed water through the lower circulating pipe *B*. These pipes and fittings are made abundantly heavy; the drum *D* is of steel tested to 500 lbs. The steam-pipe is 0½ in. in diameter.

The steam drum is 12 in. high by 6 in. in diameter, and with that portion of the steam-pipe which passes through the flow-pipe, gives a total of about 2½ square feet of heating surface.

The heater *C* is connected by the pipes *B B* with the water-back *A*, which serves as the heater when fire is used. This water-back is one-fourth of the circumference of the fire-pot.

One of the circulating pipes, *B B*, enters the circulating vessel *C* at a higher level than the other. The circulating vessel is fitted on top with the 2½-in. flow-pipe. The vessel is 12 in. in diameter and 18 in. high, having a conical or tapered form, made of steel and subjected, with the water-back and circulating pipes, to an hydraulic test of 300 lbs. per square inch.

These circulating parts, furnished with the steam-heating drum *D*, supply pipe *E*, and waste pipe *F*, are fitted to a cylindrical cast-iron frame, *I*, fig. 2, with semi-circular deflecting plate I_1 around water circulating vessel *C*. This plate I_1 is to prevent the gases of combustion passing directly from the combustion chamber to the chimney and to cause them to pass around the circulating vessel before escaping.

An opening in the casting above the fire-pot is fitted with a door having a suitable fastener; through this the fuel is supplied to the fire. The fire-pot is of cast iron; one-fourth of its circumference being formed by the water-back *A*, it is shaped to hold a large supply of fuel.

When fire is used the heater may be operated as an ordinary stove, requiring little or no more attention. The base is, of course, made so as to be properly fastened to the floor of the car, and the whole heater is covered with a sheet-iron case, which encloses the heater itself, circulating pipes, etc.

The supply of water is kept up from the tank *T*, which communicates through the pipe *N* with the flow-pipe. The waste of water is, however, very small, and the tank does not require much watching.

In a car provided with this heater the flow in the pipes may be controlled and stopped without any increase of pressure, and the heating surface can therefore be divided into sections, so that more or less radiating surface may be used, if desired; in this way in a drawing-room or sleeping-car divided into sections, the heat can be shut off from any part of the car as from a room in a house, giving an opportunity to regulate the heat as desired without affecting the temperature of the rest of the car. The makers claim the further advantage that hot water for washing, etc., may be taken off from the pipes wherever needed by simply putting in a valve at the proper point. In this way a supply of warm water for wash-basins in the car may be ob-

tained by simply increasing the size of the supply tank. There is a further great advantage in the absence of pressure in the pipes.

This heater will circulate and transmit heat through any system of pipes, and it may be applied to the pipes of the storage system by the addition of a return pipe.

The general dimensions of the heater are: Diameter of grate, 13 in.; diameter of fire-pot, 19 in.; height of fire pot, 14 in.; diameter of smoke-pipe, 5 in.; width of heater over smoke-pipe connection, 25 in.; diameter of casing, 22 in.; size of base, 22 in. by 22 in. square; height of heater, 50 in.: approximate weight, 400 lbs. It is made by the Non-Pressure Heater Company, of New York.

Bridges.

THE Atlanta Bridge Works, Atlanta, Ga., are building an iron bridge over the Chattahoochee River, near Columbia, Ala., for the Central Railroad of Georgia. This bridge has a draw span 230 ft. long, and one fixed span of 100 ft.

THE Phœnix Bridge Company, Phœnixville, Pa., has completed an iron bridge over New River at Riverview, W. Va., on the Chesapeake & Ohio road, having one span 200 ft.; one 250 ft., and one 300 ft. in length.

THE Penn Bridge Company, Beaver Falls, Pa., has just finished a new iron drawbridge over Grand River, near Painesville, O.

THE Passaic Rolling Mill Company, Paterson, N. J., is building several bridges for the Chesapeake & Ohio Railroad.

Manufacturing Notes.

THE firm of Robert Poole & Son, of Baltimore, has been reorganized as the Robert Poole & Son Company, the officers being Robert Poole, President and Treasurer; George Poole, Vice-President and General Manager; Millard S. Black, Secretary.

THE Prentiss Tool & Supply Company removes its office on May 1 to 115 Dey Street, New York. From that date the Company will act as agent for the Putnam Tool Company, of Fitchburg, Mass.

THE Johnson Railroad Signal Company is enlarging its Works at Rahway, N. J., to meet the demands of increasing business.

E. F. GARVIN & COMPANY have removed their machine shops and offices to the new building corner Laight and Canal Streets, New York.

THE Bucyrus Foundry & Manufacturing Company, Bucyrus, O., is running its works extra time to fill orders, business being very active.

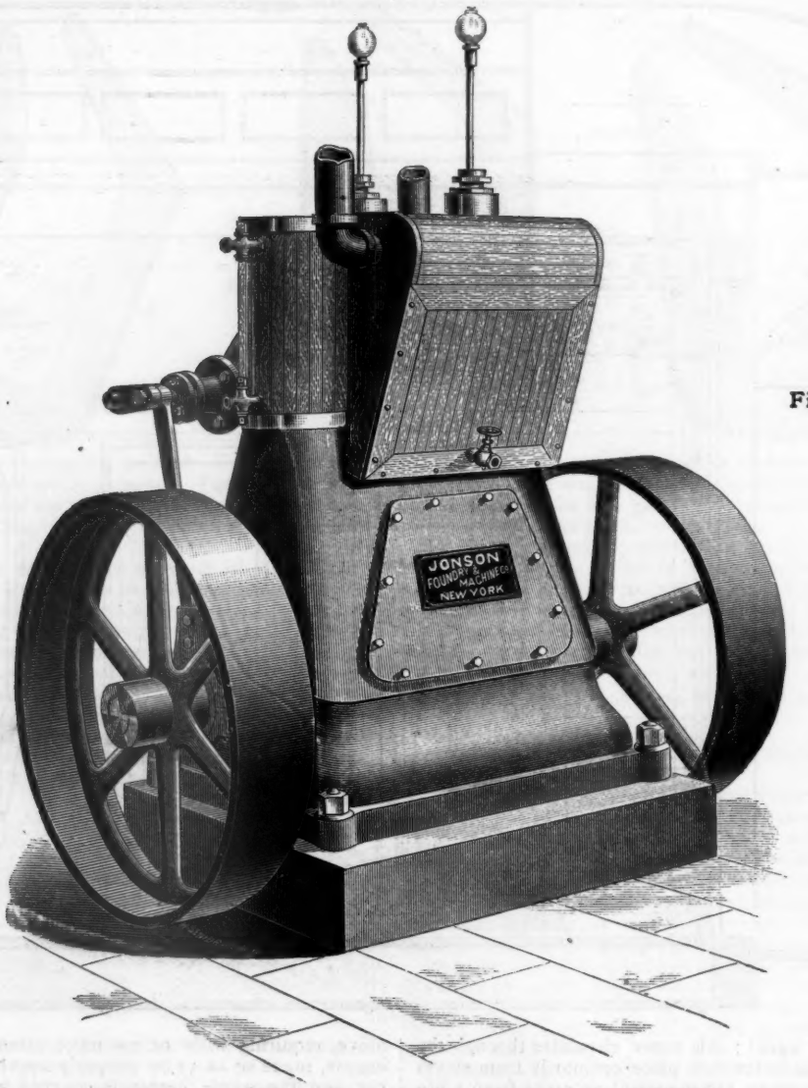


Fig. 1.

JONSON'S PATENT BALANCED COMPOUND ENGINE.

Blast Furnaces of the United States.

THE *American Manufacturers'* monthly statement gives the condition of the blast furnaces on April 1, as below: "The condensed statement is as follows:

	In Blast.		Out of Blast.	
Fuel.	No.	Weekly capacity.	No.	Weekly capacity.
Charcoal	63	12,150	103	11,751
Anthracite	100	33,267	96	24,592
Bituminous	161	106,267	84	42,398
Total	324	151,684	283	78,741

"The table shows an increase of 13 furnaces in blast on April 1, as compared with the number in blast March 1. There has been an increase of 4 in the number of charcoal, 9 in the num-

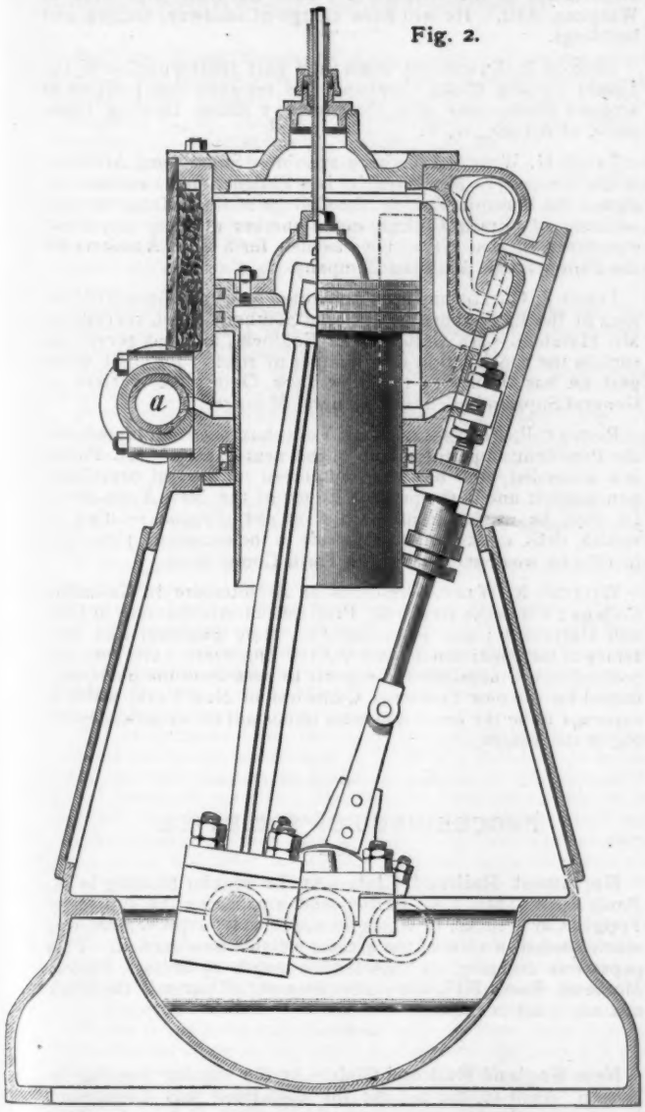
ber of bituminous. The weekly capacity of the furnaces in blast has increased from 142,734 tons to 151,684 tons.

"The appended table shows the number of furnaces in blast April 1, 1889, and April 1, 1888, with their weekly capacity:

Fuel.	April 1, 1889. No.	April 1, 1889. Weekly capacity.	April 1, 1888. No.	April 1, 1888. Weekly capacity.
Charcoal	63	12,150	60	12,393
Anthracite	100	33,267	95	27,971
Bituminous	161	106,267	130	75,983
Total	324	151,684	285	116,347

"The number of coke furnaces in blast, and the average weekly production, is greater than ever before in the history of the country, or, in other words, the rate of production of coke iron at the present time has never been exceeded. A year ago, the time of the coke strike, the rate of production was fully a third less than it is to-day, and the reduced rate of production was not confined to those furnaces running on coke alone, but applied to furnaces in the anthracite region using coke as a mixture. Leaving out of consideration the charcoal furnaces, whose make is not influenced directly by the same causes that affect furnaces running with coke or anthracite, the production of the first three months of 1889 is considerably in excess of the production for a corresponding period of 1888."

Fig. 2.



The Jonson Balanced Compound Engine.

THE accompanying illustrations represent a balanced compound engine, manufactured by the Jonson Foundry & Machine Company, of New York, the peculiar features of which are covered by patent. Figure 1 is a perspective view of the engine and fig. 2 is a section.

This engine is of the trunk type, and, as will be seen from the illustrations, consists virtually of four half-cylinders with cranks set opposite to each other, or at 180°, forming an equivalent for the ordinary high and low pressure cylinders. The area of the annular space between the trunk of the low-pressure or compound cylinder is equal to that of the high-pressure cylinder.

Thus, in the engine shown in the accompanying cut the compound cylinder is 12½ in. in diameter, while the trunk is 9⅝ in.; the difference in area is thus 122 72—72.72 = 50 sq. in., which is about the area of a cylinder 8 in. diameter, so that this engine is equivalent to an ordinary compound engine with cylinders 8 in. and 12½ diameter and 10 in. stroke. Steam is exhausted from the high-pressure end of each cylinder to the upper or low-pressure end of the same cylinder, so that the high-pressure end of one cylinder and its opposite low-pressure or compound one alternately form a complete half stroke.

Except when the engine is used for electric lighting purposes, or in very large sizes, where the slide-valves are necessarily of great area, the high-pressure steam and compound valve are made in the same casting, the high-pressure exhaust passing through ports in the valve to the low-pressure end of the cylinder; and by giving the steam, compound, and exhaust valves a definite lead, as determined by practice, both cylinders can always be made to work in unison. The two valves, however, being in the same casting and driven by a single eccentric—or in the case when the engine is used as a marine engine, by two eccentrics and an ordinary link motion—any change in this motion, as in using an automatic cut-off, affects the compound and exhaust as well as the live steam, and the makers therefore prefer to use for this purpose an independent steam valve, as shown in the cut. For marine engines the ordinary adjustable cut-off is generally used.

As above stated, where the valve area is large the builders generally prefer to divide it. They have now under construction an engine of this type of 275 H.P., which is to be used in an iron steam tender, which they are now building for the United States Government, and in this engine they use an ordinary piston valve for the high-pressure steam and a slide valve for the low-pressure or compound.

Where used as a stationary engine an automatic fly-wheel governor is used; this is not shown in the cut, as it is not an essential feature of the engine and as it presents no special peculiarities of construction.

The advantages claimed for this type of engine are compactness, freedom from vibration, low center of gravity, and the fact that, all the moving parts being exact reproductions of each other, it is perfectly balanced mechanically and can be run at a very high rate of speed, making it specially valuable for electric lighting purposes, where a quick-running engine is needed.

An engine of this type in operation runs with remarkable smoothness, showing little or no variation in speed when connected to or disconnected from a dynamo requiring about 35 H.P. It takes up very little room in proportion to the power, and appears to be adapted for a great variety of work, both as a stationary and a marine engine.

OBITUARY.

WILLIAM HARRISON, who died in Cincinnati, April 6, was an engineer of long experience. He was for 17 years employed in the office of the City Engineer. He located the Cincinnati & Eastern Railroad and had charge of part of its construction, and was also for some time Engineer of the Queen City Bridge Company.

HENRY FREEMAN GASKILL, who died in Lockport, N. Y., April 1, aged 44 years, was born in Royalton, N. Y. He began business with the Penfield Block Company, in Lockport, and afterward entered the shops of the Holly Water-Works Company as a draftsman. His ability as a mechanical engineer was appreciated, and he rose rapidly to be Vice-President of the Company. He was the designer of the well-known Gaskill pumping-engine, which is manufactured by the Holly Company.

EDWARD P. ALLIS, who died in Milwaukee, Wis., April 1, was born in Cazenovia, N. Y., in 1824, and graduated from Union College. Soon after he went West and settled in Wisconsin, where he engaged in business. In 1860 he purchased a small foundry and machine shop in Milwaukee, which was then in a bankrupt condition, and which by his energy and careful business management was gradually developed into the present extensive works of the firm of E. P. Allis & Company, which are among the largest in the Northwest, and whose work is known

all over the country. It is understood that Mr. Allis has made provision in his will for the transfer of the business to his sons.

GENERAL CHARLES KINNAIRD GRAHAM, who died at Lakewood, N. J., April 15, aged 55 years, was born in New York, June 3, 1824. In 1841, when only 17 years of age, he became a midshipman in the United States Navy; after serving a few years he resigned and became a civil engineer. In 1857 he was appointed Constructing Engineer of the Brooklyn Navy Yard, and had charge of the building of the dry-docks there. In 1861 he joined the Union Army and served through the war, rising to the rank of Brigadier-General. General Graham was Chief Engineer of the Dock Department of New York City from 1873 until 1875, and Surveyor of the Port of New York from 1878 to 1883. In 1883 he was appointed Naval Officer, which post he held until 1885; since that time he has suffered much from sickness.

CHARLES F. HATCH committed suicide at his residence in Minneapolis, Minn., April 15. Mr. Hatch was about 60 years old, and was an engineer by profession. He was employed on a number of different roads, and about 1864 became Superintendent of the Michigan Southern & Northern Indiana; when that road was merged into the Lake Shore & Michigan Southern, Mr. Hatch became General Superintendent of the consolidated line, and remained there until 1874, when he came East, to take charge of the Eastern Railroad of Massachusetts as General Manager. His administration of the affairs of that road was a short one, and after two years' service he resigned and went West again, accepting the position of General Manager of the Minneapolis & St. Louis road. He was subsequently, for a time, General Superintendent of the Chicago, St. Paul, Minneapolis & Omaha, but resigned that office about 1883. Recently he was chosen President of the Wisconsin, Minnesota & Pacific Railroad Company, and held that position at the time of his death.

MICHEL EUGENE CHEVREUL, the distinguished French chemist, who for many years enjoyed the distinction of being the oldest scientific man in the world, died in Paris, April 9, 1889, at the great age of 102 years. He was born August 31, 1786, in Angers. In 1803 Chevreul went to Paris, where his aptitudes were quickly noticed. In 1806 he was appointed director of Vanquelin's laboratory, and a professor in the Lycée Charlemagne, and during the same year he published the results of his first experiments in the form of seven papers, of which three were on coloring-matters (indigo and Brazilian-wood). Four years later he was appointed *aide-naturaliste* in the Museum of Natural History, then examiner for the École Polytechnique; and at 30 he was Professor of Chemistry in the Gobelins, the world-known manufactory of tapestry, and director of the department of tinctorial baths. In 1826, after the death of Proust, Chevreul was appointed member of the Academy of Sciences. In 1830 he became Professor in the museum, and some time after Director. He never missed a meeting of the Academy of Sciences up to his one hundredth birthday. A catalogue of Chevreul's works would be a work in itself. The two most important branches of science studied and developed by him are the chemistry of fatty substances and the theory of complementary colors. A statue of Chevreul was unveiled at the Paris Museum on his one hundredth birthday.

PERSONALS.

ANDREW J. COOPER has been appointed City Engineer of Easton, Pa.

R. H. TEMPLE, of Richmond, Va., is Chief Engineer of the Tennessee Midland Railroad.

J. F. O'ROURKE has been appointed Resident Engineer on the construction of the Chignecto Ship Canal in Nova Scotia.

J. H. SAMPLE has resigned his position as Chief Engineer of the Louisville, St. Louis & Texas Railroad on account of ill-health.

JOHN C. PAUL has been appointed Superintendent of Equipment of Pullman's Palace Car Company, and will have his office in Chicago.

H. M. PERRY, for some time past with the Pullman Company, has been appointed Manager of the Southern Car Works, at Knoxville, Tenn.

ROBERT ANDREWS, who has been chosen Vice-President of the Safety Car Heating & Lighting Company, New York, was for a number of years connected with the Wabash Railroad as Chief Engineer and afterward as General Superintendent.

H. FRAZIER has been appointed Superintendent of Roadway of the Chesapeake & Ohio Railroad. He was recently on the Louisville & Nashville.

C. M. COOK has been appointed Engineer of Maintenance of Way of the Buffalo, Rochester & Pittsburgh Railroad, with office at Bradford, Pa.

CHARLES BLACKWELL has resigned his position as Engineer of the Machinery Department of the Central Railroad of Georgia. His address for the present is Savannah, Ga.

T. APPLETON has been appointed Resident Engineer on the Union Pacific, with headquarters at Omaha, Neb. He was recently Secretary of the Elastic Nut Company of Milwaukee.

F. E. NELSON has been appointed Superintendent of Road Department of the Atlantic & Pacific Railroad, with office at Williams, Ariz. He will have charge of roadway, bridges and buildings.

GEORGE F. EVANS, for some time past representative of the Eames Vacuum Brake Company, has resigned that position to accept a similar one with the McElroy Steam Heating Company, of Albany, N. Y.

JAMES H. WINDRIM has been appointed Supervising Architect of the Treasury. Mr. Windrim is a Philadelphian, and has designed the Masonic Temple, the College of Physicians, the new building of Girard College, and a number of other important structures in that city. He was also for a time Architect for the Pennsylvania Railroad Company.

JAMES E. CHILDS has been appointed Assistant General Manager of the Lake Shore & Michigan Southern Road, succeeding Mr. Harahan. Mr. Childs is an Engineer, and has served as such in the construction of a number of roads; for eight years past he has been with the New York, Ontario & Western as General Superintendent and General Manager.

ROBERT P. PORTER, of New York, has been appointed, by the President, Superintendent of the next census. Mr. Porter is a journalist, who has been employed on several prominent newspapers, and is the present Editor of the New York *Press*. In 1879 he was appointed Chief of the division relating to wealth, debt, taxation, and railroads in the census of 1880, and in 1882 he was Secretary of the Tariff Commission.

WILLIAM R. WARE, Professor of Architecture in Columbia College; CHARLES BABCOCK, Professor of Architecture in Cornell University; and JOHN BOGART, State Engineer and Secretary of the American Society of Civil Engineers, have been appointed as a Commission of experts to pass upon the plans submitted for the new Episcopal Cathedral in New York, which is expected to be the finest and most important ecclesiastical building in this country.

PROCEEDINGS OF SOCIETIES.

Northwest Railroad Club.—At the regular meeting in St. Paul, April 5, Mr. J. C. Barber read a paper on the subject of Freight Car Trucks, in which he urged that improvement was much needed in view of the greater weights now carried. This paper was discussed at considerable length by Messrs. Pattee, Mathews, Reed, Hill, and others present, all parts of the truck coming in for criticism.

New England Railroad Club.—At the regular meeting in Boston, April 10, the subject for discussion was Compound Locomotives, and a paper on the question was read. This called out a very lively discussion from members present, in which, as might have been expected, there were wide differences of opinion.

Western Railroad Club.—The regular monthly meeting, in Chicago, April 16, was occupied by a general discussion of the Rules of Interchange of the Master Car-Builders' Association, in which several disputed points were brought up. A committee of five—Messrs. Verbryck, Schroyer, Rhodes, Barr, and Crossman—was appointed to examine the Rules and make a detailed report to the Club at its next meeting.

General Time Convention.—The spring meeting was held in New York, April 10. May 12 was the date fixed upon for the spring changes of time. The proposition to change the name of the Association was laid upon the table.

The following officers were chosen: President, H. S. Haines; First Vice-President, F. Wolcott Jackson; Second Vice-President, J. T. Harahan; Secretary, W. F. Allen.

The Committee on Train Rules reported that the standard code was now in use by 64 companies, operating 39,132 miles, and would be adopted during the present summer by 26 other companies, operating 27,398 miles. Some slight amendments were proposed. The publication of the authorized edition of the standard code has been delayed owing to the non-completion of the full set of diagrams showing manner of using signals.

The Committee on Car Mileage and Per Diem Rate presented a report recommending charging demurrage, at the rates fixed at the October meeting, and the organization of bureaus at central points, to collect such charges and to prevent the detention of cars. The report was adopted, and the Committee instructed to prepare forms for the use of such bureaus.

Railroad Superintendents' Association.—A regular meeting was held in New York, April 8. The following officers were elected for the ensuing year: President, C. S. Gadsden; Vice-President, L. W. Palmer, J. B. Morford, Waterman Stone; Secretary, C. A. Hammond; Treasurer, R. M. Sully.

Several amendments to the Constitution were proposed, and the Secretary was authorized to submit them to members by circulars. The Roadway Committee reported that the time for receiving papers for the prize offered by the Association had been extended to May 1. The Committee on Machinery presented an elaborate report, in relation to Steam-Heating of Trains.

At the afternoon session a paper by Mr. Tratman on Improvement of Track was read and referred to a committee. There was some discussion on the Code of Signals.

President Gadsden read a paper on Discipline, which was generally discussed by members present.

It was resolved to hold the next meeting in New York. A committee was appointed to consider the question of procuring permanent headquarters in that city.

American Society of Mechanical Engineers.—The following circular has been issued by Secretary F. R. Hutton to members of the Society:

"The Council, at a recent meeting, canvassed the replies from the members in reference to the question of an up-town or down-town location of the Society's rooms and library.

"The result of that vote showed that a decided majority favor an up-town location, where rooms and library could be kept open in the evenings, but a general opinion opposed, at this time, to undertaking the responsibility of an entire house, with its increased cost.

"Arrangements have, therefore, been perfected in carrying out the expressed preferences of the voting members to secure such accommodations as would be suitable in the central or hotel district of the city. The Council have leased the entire ground floor of No. 64 Madison Avenue, New York, which will be the Society's address after April 20, 1889, until further notice. This house will offer to the Society three large rooms on the ground floor, well lighted and comfortably furnished, and suitable for the present needs of the library and office. The avenue location is a pleasant one, just above Twenty-seventh Street, and one block north of Madison Square, near all the hotels which have congregated at this section, and within three short blocks of the building on Twenty-ninth Street, which has been secured by the Engineers' Club. During the summer season, and until October 1, 1889, the rooms will be open as now, from 9 in the morning until 5:30 in the evening; but after that date it is proposed to have them open also in the evenings, in charge of a custodian, so that the members, both resident and non-resident, may be able to make use of them at hours when they are less pressed for time than during the business day. The library of exchanges and periodicals is steadily growing, and the current files of journals are open for consultation, to say nothing of the regular issues of the societies, American and Foreign, which are on the library shelves.

"A later notice in the autumn, after the return of the entire European party, will announce the beginning of evening openings. As stated above, this feature will not be inaugurated until October 1."

American Water-Works Association.—The annual convention was held at Louisville, Ky., April 16, 17 and 18. The list of papers to be read is as follows:

Water-Works Records, by J. M. Diven; Flushing Street Mains, by H. W. Ayres; Increased Revenue from Private Sources, by C. N. Priddy; Hydraulic Elevators Operated by Direct Pressure, by G. A. Ellis; Use of Liquid and Gaseous Fuels, by L. H. Gardner; Pressure Regulators for Water-Works, by William Ryle; Analysis of Mechanical Filter Actions, by Emil Geyelin; Water-Works Construction from an Engineering, Financial, and Municipal Point of View, by F. H. Pond; Classification of Water Rates, by J. Nelson Tubbs; Purification of Water for Boilers, by F. W. Gerecke; Standard Water Pipes, by D. B. Russell; Aeration and Sedimentation of Muddy River Water, by Professor J. B. Johnson; The Hardness of Water, by Professor A. R. Leeds; Relation between Plumbers and Water Companies and Departments, by B. F. Jones; Some of the Difficulties in Establishing a New Public Water-Supply and Its Improvement, by W. J. Milner.

Besides this programme opportunity was given for discussion of papers read, for the presentation of volunteer papers, and of questions for discussion by members. Arrangements were also made for social meetings, excursions, etc.

In connection with the meetings there was an exhibition of machinery and appliances for water-works manufactured by associate members.

Philosophical Society of Washington.—At the regular meeting, March 30, a paper was read by Mr. J. Elfreth Watkins, Curator of the Section of Transportation at the National Museum, on The Origin of the Railroad Systems of England and America, and the Causes of the Differences. Mr. Watkins first discussed the beginnings of modern transportation. The time was ripe for the railroad and the steam locomotive when it came. In England the demand for coal becoming more and more urgent as the forests disappeared directed thought toward the improvement of modes of transporting it from the collieries. The growth of the iron industry also called for cheap methods of procuring coal. Wooden rails, from the collieries to the water courses, on which cars were drawn by horses, materially reduced the cost of coal used for manufacturing and for household purposes. The improvements made by Watt in the steam-engine, between 1775 and 1785, aided in mining coal and increased the production. As coal was cheapened the price of iron was reduced, and it became possible to use iron rails for the tram-roads. Mr. Watkins traced the development of the rail and exhibited drawings of the rail, designed by Robert Stevens, of America, the first rail rolled with a base, which marks the American system.

The Engineers' Club.—The Engineers' Club has secured permanent quarters in New York, having leased a large double house on West Twenty-ninth Street, near Fifth Avenue, immediately opposite the Law Library. The house is large, and can easily be fitted up for the accommodation of the Club, which has already a large membership, and starts off with its affairs in excellent condition.

American Society of Civil Engineers.—At the regular meeting of March 20, Mr. Charles Macdonald delivered an interesting lecture on the Progress of the Forth Bridge, illustrated by stereopticon views from photographs taken at different times.

AT the regular meeting of April 3, the Secretary announced that it had been decided to hold the next convention of the Society at Seabright, N. J., during the latter part of May, just previous to the departure of the European party, which is to be on May 29. The deaths were announced of John Ericsson, elected honorary member of the Society October 2, 1879, and of E. P. Allis, elected fellow of the Society August 4, 1883, and the preparation of the customary memoirs was directed.

A comprehensive paper by Emil Kuichling on Experiments on Flow in Combined Sewers, discussing the relation between rainfall and sewer discharge in urban and suburban districts, was read by the Secretary, and discussed by Rudolph Hering and others. The paper gave some results of practical experience gained by experiments and observation.

The tellers announced the following election:

Members: Willard Beahan, Santiago, Chili; Edward J. Blake, St. Joseph, Mo.; Horace J. Campbell, Chicago; William W. Coe, Roanoke, Va.; Fayett S. Curtis, New Haven, Conn.; John R. Freeman, Boston; Franz Germain, Colon, Isthmus of Panama; Frank P. King, Denver, Col.; John N. Pott, Wilkes-Barre, Pa.; John J. Robinson, Johnson City, Tenn.; Martinius Stixrud, Seattle, Wash.; Timothy S. White, Beaver Falls, Pa.

Juniors: William B. Ewing, Chicago; John E. Griffith, Donald, B. C.; Clifford S. Kelsey, New York; Curtiss Millard, Yonkers, N. Y.; Elstner Fisher, Benno Rohnert, Detroit, Mich.

AT the regular meeting, April 17, the Secretary read a paper on the Mississippi as a Silt-Bearing River, by William Starling, Chief Engineer of the Mississippi Levee Commission. This paper was discussed by members present.

The Committee on the relation of the Sections of Railroad Wheels and Rails ask that discussions on the subject and replies to the circular of the Committee be sent in immediately.

Boston Society of Civil Engineers.—At the regular monthly meeting, April 17, memoirs on the late S. M. Felton and the late E. S. Philbrick were read. Messrs. W. C. Boyce, Edmund Grover, F. E. Hosmer, and F. B. Rowell were chosen members.

Mr. L. D. Bidwell read a paper on the Relocation of the New York & New England Railroad at the Sodom Dam. Mr. Samuel M. Gray read a paper on the Proposed New Terminal Facilities in Providence.

Engineers' Club of Philadelphia.—A regular meeting was held March 16.

Mr. J. E. Codman presented notes on a Test of Riveted Steel and Iron Plates, exhibiting the test specimens. These were discussed by Messrs. Marichal and Morris.

Professor L. M. Haupt presented notes upon the Permeability of Cements and Mortars.

A description of the Compound Steam Turbine and Turbo-Electric Generator, derived from a paper presented by Hon. Charles A. Parsons to the Institution of Mechanical Engineers of England, was presented by Mr. J. E. Codman.

At the regular meeting of April 6, the entire session was taken up in the presentation and discussion of a series of amendments to the constitution and by-laws of the Club. These amendments are to be voted upon separately by letter ballot at the next business meeting.

Engineers' Society of Western Pennsylvania.—At the regular meeting for April, the Committee on Transfer of Members made a report recommending a system of visiting cards, and was instructed to confer with other societies on this matter.

The Committee on Improvement of Country Roads presented a report, recommending a division of such roads into three classes, highways, roads and lanes, according to their relative importance, and also the appointment of road commissioners and of county engineers, to have charge and control of the improvement and maintenance of the roads. The Committee also presented a draft of a bill to be submitted to the Legislature carrying out these changes. The report was adopted by the Society, and the committee instructed to use every means to support the bill in the Legislature.

A paper on Optical Glass was read by Mr. John A. Brashear, giving an interesting account of the method of manufacturing this glass. He claimed that such glass ought to be made in Pittsburgh, as all the requisites could be obtained there, and it needed only the skill and patience of trained employés.

Engineers' Club of Cincinnati.—At the regular meeting, March 28, Messrs. A. I. Totten, William Archer, E. W. Wulfekoetter, and John G. D. Mack were chosen members.

In the absence of any regular paper, Mr. R. L. Read gave a lengthy and interesting description of the new freight depot and storage warehouse recently constructed under his supervision by the Cincinnati, Indianapolis, St. Louis & Chicago Company, at Cincinnati, to replace the old and inadequate sheds which have served for many years. These improvements are quite attractive and commodious, affording a large amount of storage room for flour and other goods, and convenient and well-adapted accommodations for the handling of the large freight business done by the road.

Mr. Anderson described a bridge which he had designed to carry a sewer drain across a ravine at the new military post being established at Newport, Ky. The bridge, which is a masonry arch of 60 ft. span, and having a rise of 6 ft., presents some original features of construction which were discussed at some length by those present.

Western Society of Engineers.—The regular meeting of the Society was held in Chicago, March 6.

Application for membership was made by Mr. John S. Glenn. Messrs. Edwin G. Nourse, James K. Lyons, Charles C. Brokaw, and Richard O'Sullivan Burke were elected members.

Mr. F. C. Rossiter, of the Committee on Standard Drawing Papers for Engineers, introduced some samples of profile paper which had been prepared for blue printing.

The Secretary presented the financial report of the month. The resignation of the Treasurer, H. W. Parkhurst, was received and accepted.

A committee of three was appointed to secure proper quarters for the Society.

The question of voting on the amendment to increase the annual dues was discussed by Messrs. Nagle, Liljencrantz, Lundie, Carter, and the Secretary.

A paper on the Croton Valley Storage, by Samuel McElroy, was ordered to be read at the next meeting.

Civil Engineers' Club of Cleveland.—The annual meeting was held in Cleveland, O., March 12. The reports of the officers showed the Club to be in a prosperous condition. The following officers were chosen for the ensuing year: President, W. R. Warner; Vice-President, H. C. Thomson; Treasurer, S. J. Baker; Secretary, James Ritchie; Corresponding Secretary, A. H. Porter; Librarian, J. L. Gobeille; Member of Board of Managers, W. H. Searles.

The annual dinner of the Club was given March 14, and there were present about 75 members and guests.

Civil Engineers' Society of St. Paul.—The regular monthly meeting was held April 1. Mr. Lehman was elected a member of the Society.

The paper of the evening was by Mr. E. E. Woodman, on The Legislative Control of Railways; this was discussed at considerable length by members present.

Engineers' Club of St. Louis.—The regular monthly meeting was held March 20.

Vice-President Nipher addressed the Club, on Plans of Investigations in Dynamo Designing. His remarks were illustrated by drawings and by formulæ and sketches on the blackboard.

Professor Johnson submitted a brief reply to Mr. William B. Knight's discussion of the paper on Cable Yokes. This was discussed by the members present.

At the regular meeting, held April 3, O. E. Hovey and H. Krutzsch were elected members.

A paper on Street Car Running Gear was read by Mr. B. F. Crow and discussed by Colonel Meier, Professor Johnson, J. A. Seddon, Mr. Robert Moore, Professor Nipher, Mr. Hubbard, and Mr. Taussig.

Mr. W. H. Bryan read a paper on Steam Plants for Electrical Service, which was discussed by members present.

Engineers' Club of Kansas City.—This Club has obtained a room of its own for meetings, which will also be used as a reading-room for the convenience of members.

At the regular meeting, April 1, R. L. McAlpine was elected an Associate Member. Letters were received in reference to the transfer of members and the subject was discussed, the general opinion being that some system of transfer should be arranged.

Mr. Taylor's paper on Strengthening Railroad Bridges was discussed by Messrs. Goldmark and Breithaupt.

A paper on Pollution, with special reference to water supply and sewerage, was read by Mr. Kenneth Allen.

Organic impurities were especially referred to; their detection by chemical and biological analysis; the character and action of bacteria briefly described; and the allowable limits of impurities mentioned.

After discussion by Messrs. Breithaupt, De Courcy, and Elliot, the President introduced Dr. F. B. Tiffany as a pupil of Dr. Koch, of Berlin. Dr. Tiffany exhibited specimens of Anthrax Bacilli, Infusoria from hay infusion, water from O. K. Creek sewer, and other specimens under microscopes magnifying 400 and 800 diameters.

Civil Engineers' Association of Kansas.—The following officers have been elected for the ensuing year: President, O. Mulvey; Vice-Presidents, W. A. Crusinberry and W. R. Kesler; Librarian, H. H. Jackman; Treasurer, Ransom H. Brown; Secretary, J. C. Herring.

At the regular meetings, held on the first Wednesday of each month, original papers are read and discussed.

Master Mechanics' Association.—The committee of which Mr. John Hickey, of the Milwaukee, Lake Shore & Western road, is Chairman, has issued a circular of inquiry in relation to the question as to whether the Water Space Surrounding the Fire-Box and the Flues of Locomotives is Usually Large Enough for Free Circulation.

Another circular has been issued by the Committee on Tires, of which Mr. Henry Schlacks, of the Illinois Central, is Chairman, requesting information on the Wear of Tires and upon

the Relative Advantages and Disadvantages of Using Heavy or Light Tires on Locomotive Driving-wheels.

Montana Society of Civil Engineers.—At a meeting held in Helena, Mont., March 16, the Committee on Highway Bridges reported in favor of co-operating with other engineering societies to secure the desired reform, but considered that it is not expedient, in so new a country as Montana, to attempt the passage of any inspection law at present. This report was adopted as the sense of the Club.

Master Car Builders' Association.—The following is the letter of resignation of Mr. Forney, which was submitted at a meeting of the Executive Committee held on March 15.

NEW YORK, March 14, 1889.

To the Members of the Executive Committee of the Master Car Builders' Association:

GENTLEMEN: As other interests demand all of my time and attention, I have decided that I will not accept a reappointment as Secretary of the Master Car-Builders' Association should it be tendered to me after the next annual convention. As the business of last year has all been completed, and little or none of that for the current year has yet begun, it seems to be desirable, if a new incumbent of the office is appointed, that he should assume its duties before rather than after the convention, so that he will become familiar with the business which must be transacted during the meeting, which must be embodied in the annual report for the current year. For these reasons I hereby request the Executive Committee to relieve me of the office and duties of Secretary of the Association at as early a date as it may be possible to agree upon my successor.

In relinquishing my official relations to the Association I feel sure that it will be a pleasure to me hereafter to remember the acquaintances and friendships which have been made during the time that I have occupied the position of Secretary and to recall the period of my term of office. Trusting that the pleasant personal relations of the past will be continued and that the prosperity and usefulness of the Association may increase in the future, as it has in the years that are left behind, I am,

Very respectfully,

M. N. FORNEY.

The letter was received by the Committee, and a resolution was adopted that Mr. Forney's resignation be accepted, to take effect as soon as a successor in the office of Secretary is installed. Mr. John W. Cloud was then appointed to fill the vacancy; he has since then accepted the office, and may be addressed at Buffalo, New York.

NOTES AND NEWS.

The Laon Steep-Gradient Railroad.—The tramway laid down along the highroad to connect Laon with the station of the Northern Railroad of France has a gauge of 1 ft. 11⅝ in.; its rails are of steel, weighing 19¾ lbs. per lineal yard, carried on steel sleepers, 3 ft. 3½ in. long, hollow underneath, and closed at the ends on Captain Pechot's system. The line, which surmounts a difference of level of over 328 ft. in about 1¼ mile, has necessarily steep gradients, reaching to 1 in. 15.4, with curves having a minimum radius of 1¼ chain. The traction is effected by a compound locomotive, on the Mallet system, weighing 8.8 tons when empty, and 10.8 tons when loaded. This engine has four axles, to make the load borne by each as small as practicable; all its wheels are driving-wheels, to utilize the whole weight of adhesion; and the front set of wheels are made convergent, so that the engine can go readily round curves of one chain. The heating surface is 254 sq. ft.; the hinder, high pressure cylinders have a diameter of 6¾ in., and 10¼ in. stroke; while the front cylinders, low-pressure, have a diameter of 10 in., and the same stroke; and the wheels are 1 ft. 11⅝ in. in diameter. The total wheel-base is 9 ft. 2 in.; but the distance apart of each pair of axles is only 2 ft. 9 ½ in. The locomotive has a tractive force of 1.43 tons at the tires of the wheels when running compound, but by the admission of live steam into the four cylinders, this force can be raised to 2.07 tons. This latter method of working, however, is only exceptionally used, to overcome excessive temporary resistance. The carriages are on trucks, and have seats for 24 passengers, and standing-room for eight more; so that the ordinary train of three carriages can convey 96 passengers, amounting, when filled, to a load of 12 to 13 tons. The laying of the line was effected by 50 workmen in three days with satisfactory results.

The Vestibule Car Patents.—In the United States Circuit Court, in Chicago, April 17, a decision was given declaring the Sessions patent on vestibule cars valid, and holding that the Wagner Company was infringing it. The Court held that none of the patents brought up anticipated the Sessions invention, and that the old devices brought forward to invalidate it were without standing. It was therefore ordered that the temporary injunction against the Wagner Company be made permanent, and that a master be appointed to take testimony as to damages.

The Sessions patent covers the iron face-plates on the vestibules, held together by springs, which make a tight joint between the two vestibule portions of the car, when the train is in motion.

The Wagner Company claims that this decision will not prevent them from using the vestibule cars, as the platform arrangement can be successfully used without this device, and others can be substituted for it.

A Cuban Bridge.—A Cuban Exchange describes a new iron bridge recently erected across the valley of the Purial River, on the Soledad & San José Railroad, in that island. The total length of the bridge is 360 ft. divided into 10 spans, the longest being 72 ft., the others of 35 ft. 9 in. and of 18 ft. The bridge is supported by two stone abutments, one stone pier and 8 iron piers or towers, resting on stone foundations. The iron used is old rails, 18 ft. in length. The iron towers or piers each consist of 12 rails set upright and covered with a wrought-iron cap, upon which the trusses rest.

In the short spans the lower chord consists of a single rail, the upper cord of two rails, held together by bolts 1⅛ in. in diameter, passing through thimbles or distance-pieces, which hold the two rails at the proper distance apart. In the 72-ft. span the lower chord consists of two rails, and the upper chord is in the form of an arch; the truss is braced by 32 rods 1¼ in. diameter and 16 1-in. rods, extending from chord to chord. This truss is 10 ft. 4 in. in depth, and the trusses are spaced 11 ft. 8 in. apart from center to center. The lower chord is 30 ft. above the level of the river. One of the iron piers is 13 ft. in height from the stone foundation to the iron cap, and the others are 26 ft.

The bridge was calculated to support a moving load of 63 tons, on each 36 ft. in length, trains to run at a speed of 25 miles an hour. In testing the bridge a train consisting of a locomotive 21 tons in weight, and nine cars heavily loaded with wood, was used, and tests were made with the train at rest and running at full speed. It should be observed that the trains pass upon the bridge from a heavy down grade.

This bridge was built for Mr. John W. Hoes in the shops of the Guantanamo Railroad, by Mr. Walter S. Phelps, Superintendent of Machinery of the road.

We may here mention that the shops of the Guantanamo Railroad, under Mr. Phelps's charge, have, during the past four years, built a locomotive—the first complete locomotive ever built in the Island of Cuba—a steam-car, the iron bridge above mentioned, and another one 200 ft. in length, a new passenger car, and furnished repairs and new machinery for 22 coffee and sugar plantations, besides doing all the regular repair work of the railroad, making a variety of work not often found in a railroad shop.

Passenger Travel on German Railroads.—The statistics of the German railroads for last year show a considerable increase in passenger travel, the total number carried rising from 295,758,906 in the preceding year to 315.991,747. The increase in mileage of the roads was not large, the average in 1887–88 being 39,261 kilometers against 38,261 in the preceding year. The first class alone decreased, all the other classes having increased in number. Germans travel much, but in this, as in all other things, they are thrifty, and spend as little as possible. The great bulk of the passengers on German roads take the cheaper class of cars, so that the first class are very little patronized. The division of passengers for two years past was as follows:

	1887–88.		1886–87.	
	Number.	Per cent.	Number.	Per cent.
First class	1,807,647	0.4	1,864,596	0.6
Second class	32.869,910	10.4	31,724,493	10.7
Third class	206.624.435	65.4	193.131,225	65.3
Fourth class	67,359 874	21 4	62,081,560	21.0
Military	7,329.881	2.4	6,957.032	2.4
Total	315,991.747	100.0	295,758,906	100.0

The number of fourth-class passengers would probably have been greater, but for the fact that on nearly all the South German Railroads there is no fourth class, the third class being the lowest in use. The third and fourth class together last year included 86.8 per cent. of all the passengers carried.

Railroads in the Philippine Islands.—The first railroad in the Philippine Islands was recently opened for business. It is a narrow gauge line, five miles in length, extending from Manila to Malabon, on the southwest shore of Manila Bay, where a large sugar refinery is in active operation. The road

is solidly built, the bridges being of stone. It is equipped with four locomotives of German manufacture, and with a passenger car and 10 freight cars of English make.

Work is in progress on a narrrow-gauge line from Manila to Dagupan on the Island of Luzon, which will be 120 miles in length. Lines are also proposed from Manila to Cavite, about 30 miles, and from Manila to Antipolo, 18 miles, but work has not been begun. The Island of Luzon is very densely populated and very productive, and could, it is thought, furnish traffic for these lines without difficulty.

A Revolving Battery.—The accompanying illustrations show a design recently patented for a revolving marine battery, which may be properly described as being a monitor turret set afloat by itself, without a monitor hull under it. The hull of the vessel, as will be seen, consists of two concentric rings con-

Fig 1

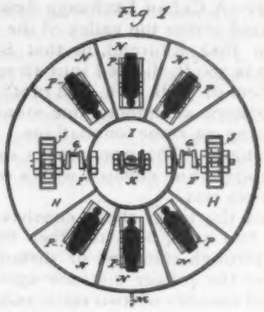
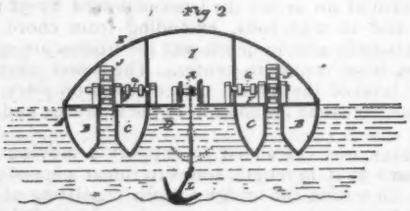


Fig 2



nected so as to form one structure, leaving a clear central space within. The battery itself is made of dome shape, and engines are provided for manœuvring the ship, if it may be called so. These engines are so arranged that they can be used to propel the battery from one place to another, a temporary rudder being provided for this purpose, or they can be used to revolve the turret in the water when anchored, as shown in fig. 2.

Incidentally, it may be remarked that this construction bears a sort of family resemblance to the circular monitors or *Popoffkas*, as they were called after their inventor, a number of which were built some years ago for the Russian Navy. The Russian authorities never made public any particulars in relation to these singular vessels, but it has been generally understood that they were not by any means a success.

The battery shown here is the subject of United States patent No. 400,836, dated April 2, 1889, and granted to Lockwood Durand, of Huntington, Conn.

Swiss Cable Railroads.—Several new cable roads are to be undertaken in Switzerland during the present season. A contract for a cable line from Acluse to Plau has been let; this road will be about 1¼ miles long, with an average grade of about 15 per cent.

Another line in progress will run from St. Gall to the summit of one of the neighboring hills. It will be about 11,000 ft. in length, with grade varying from 19 to 25 per cent.

A third line to be built will extend from Lauterbrunnen to Murren. From Lauterbrunnen to Gratsch this will be a cable railroad, the cables being worked by water-power; from Gratsch to Murren it will be an electrical line, the dynamos furnishing the power being also worked by water.

International Congress of Applied Mechanics.—There will be held at Paris, at the Conservatoire des Arts et Métiers, an International Congress of Applied Mechanics, under the patronage of a Committee of Honor comprising savants and engineers of renown both from France and from other countries, who will give the work of the Congress the benefit of their influence and the weight of their authority. The President of the Committee on Organization is M. Phillips, ex-Inspector General of Mines. The five members appointed from the United States are, in the order of their mention on the official bulletin, Robert Grimshaw, Professor R. H. Thurston, Professor Egleston, and the Presidents of the American Societies of Civil and of Mechanical Engineers.

At this Congress, among the important subjects submitted for discussion are the unification of the horse-power; the choice of materials in machine construction; the mechanical production and utilization of artificial cold; transmission to a distance and distribution of work by other means than electricity (water, air, steam, cables, etc.); automatic cut-off engines, with several successive cylinders; thermo-motors other than the steam-engine.

Other topics, treated by papers, will be improvements in steam-engines since 1878; progress among associations of owners of steam appliances; and improvements in apparatus for the generation of steam, more particularly sectional boilers.

Foreign Naval Notes.—The new Russian ironclad which has been commenced at Nicolaieff will be called the *Twelve Apostles*. It will be 8,076 tons displacement, and will be protected by a belt of armor of 14 in., and will be provided with engines developing upward of 8,500 H.P. The *Hangut*, another vessel for the Russian Navy, of 6,590 tons, has just been laid down at the Admiralty works, St. Petersburg. This vessel will have only a partial armor.

The British Admiralty programme for the building of new ships does not involve so large an addition to the Navy as was hoped for, but as regards the types of ships to be built appears eminently satisfactory. Eight large battle-ships are to be built. They will be really enlarged *Trafalgars*, of over 14,000 tons displacement and 17½ knots speed under forced draft. Their armor belt near the water-line will extend two-thirds of their length, and will be 18 in. thick, and the upper part of their broadside will be protected by 5-in. armor, which will keep out the shot of quick-firing guns. The second-class ironclads will be similar in design to the first-class, but will have lighter armor and armament and will be of 9,000 tons displacement.

A number of first-class cruisers are to be built to steam 20 knots, with a displacement of 7,350 tons, having no side-armor, but a 5-in. armored deck. A second-class cruiser, of which a large number will be built, will steam 20 knots, with a displacement of 3,400 tons, and will have a 2-in. armored deck. Besides these there will be some cruisers of another type for distant service, and some more torpedo gun-boats. Half of the new vessels will be built in the Royal dockyards, and half by contract.—*Nautical Magazine.*

The Gatling Torpedo Boat.—The accompanying illustration shows a combined torpedo and gun-boat, designed by Richard J. Gatling, of Hartford, Conn.; fig. 1 being an elevation, and fig. 2 a deck plan of the vessel. The essential object of this design, as stated by the inventor, is to provide, in connection with a light-running and noiseless steam launch of great speed, a spar or boom capable of changes of position, an explosive or torpedo carried by said spar with improved machinery for operating it, a gun for throwing a high explosive against the side of a ship to be destroyed, and an annex or compartment for the torpedo operators attached to the stern of the boat, so that the boat itself becomes a shield to protect the operators from shots

Fig. 1.

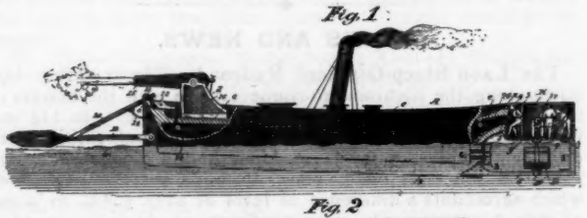
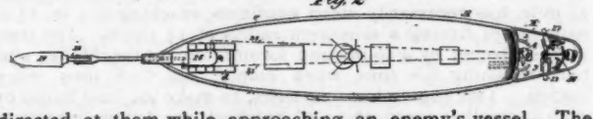


Fig. 2



directed at them while approaching an enemy's vessel. The general design will be readily understood from the engraving.

No special construction of hull or engines is provided for, the main requirements of such a boat being, of course, the greatest possible strength, combined with speed and lightness.

This design for a combined torpedo and gun-boat is the subject of letters-patent 399,516, dated March 12, 1889, and granted to Richard J. Gatling.

Railroads in New South Wales.—The report of the Commissioner of Railroads, for the year ending June 30, 1888, shows that on that date there were in operation in the Colony 2,112 miles of railroad, of which 197 miles were added during the year. There were 66 miles of new road under construction, a smaller amount than for several years past. The total cost of the railroads has been about $138,000,000, and their net earnings last year were somewhat less than 3 per cent. on the capital invested. The report complains that the earnings of the roads had been somewhat restricted by lack of equipment, and that more cars were urgently needed, but could not be procured, owing to the failure of the Legislature to make the necessary appropriations. All the lines are owned by the Colony.